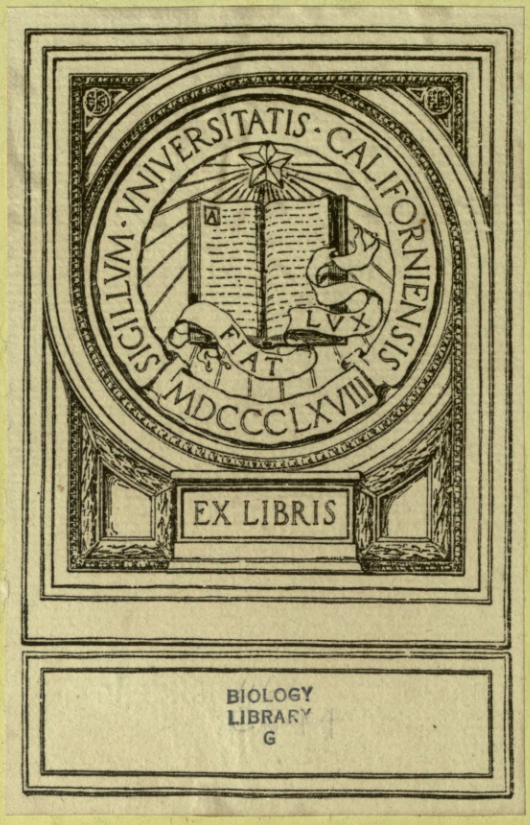

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DEER FAMILY.

1. Indian Muntjac (*Cervulus muntjac*).
2. Reindeer (*Rangifer tarandus*).
3. Javan Deerlet (*Tragulus napu*).
4. Fallow Deer (*Dama vulgaris*).
5. Wapiti Deer (*Cervus strongyloceros*).
6. Porcine Deer (*Hyelaphus porcirus*).
7. Roebuck (*Capreolus caprea*).
8. Elk (*Alces machlis*).
9. Chinese Water Deer (*Hydropotes inermis*).

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RUMINANTIA.

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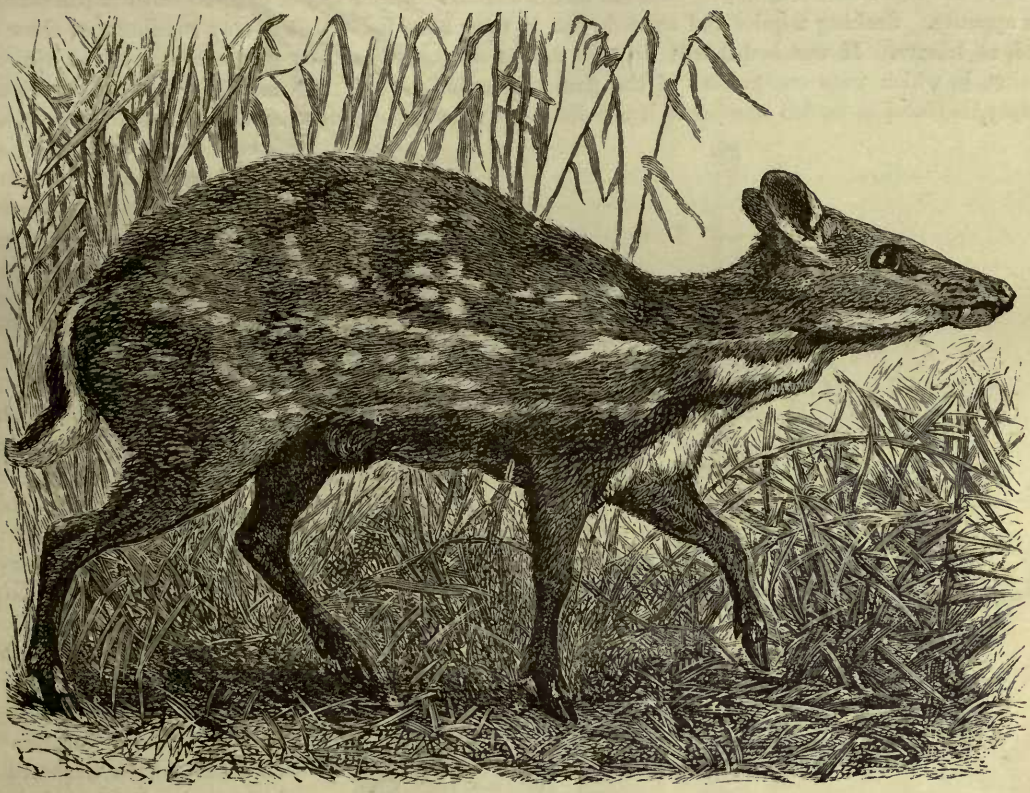
CASSELL'S NATURAL HISTORY.



WATER DEERLET, OR CHEVROTAIN.

CHAPTER I.

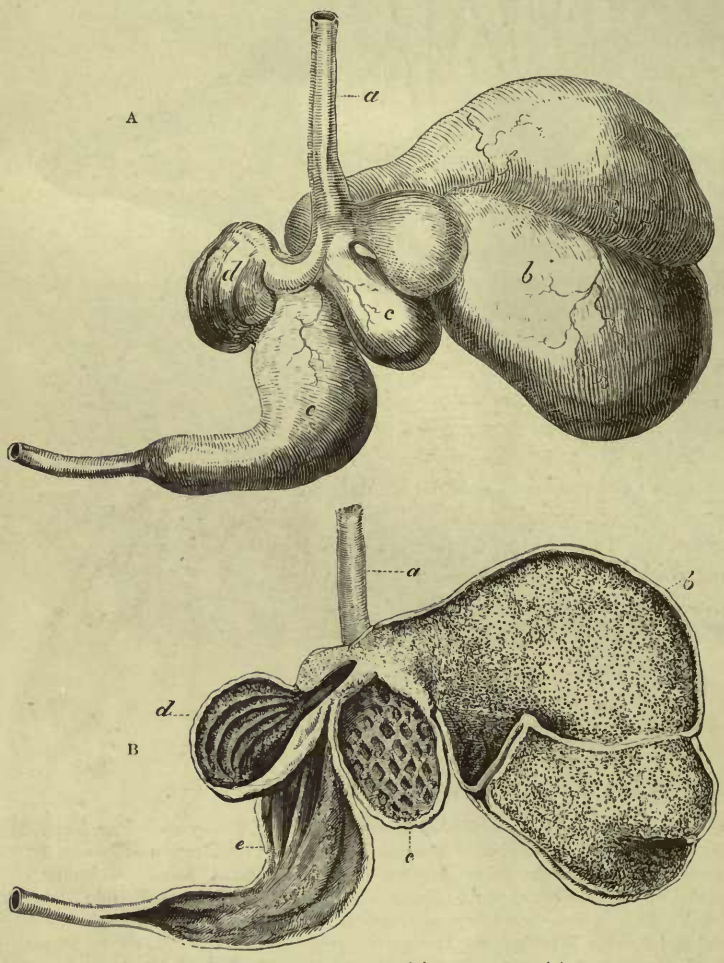
ARTIODACTYLA—RUMINANTIA: BOVIDÆ—SHEEP, GOATS, AND GAZELLES.

Ruminantia—Chewing the Cud—Metaphorical Expression—The Complicated Stomach: Paunch, Honey-comb Bag, Manyplies, Reed—Order of Events in Rumination—Feet and Dentition of Ruminants—Brain—Classification—HORNED RUMINANTS—Divided into two Groups—Difference between them—BOVIDÆ—Horns—Aberrant Members—SHEEP AND GOATS—General Characteristics—Sheep of South-Western Asia—Merino Sheep—Breeds of Great Britain—Dishley, or Improved Leicesters—Mr. Bakewell's Description—Southdowns, Cheviots, Welsh, and other British Breeds—Table of the Importation of Colonial and Foreign Wool into the United Kingdom—MARCO POLO'S SHEEP—OORIAL—SHAPOO—MOUFLON—AMMON—BURHEL—AMERICAN ARGALI—WILD SHEEP OF BARBARY—THE GOAT—Compared with the Sheep—Descent—Cashmere Goat—IBEXES—PASENG—Their remarkable Horns—Old Theories as to the Use of the Horns—MARKHOOR—TAHR—GAZELLES—General Characteristics—Sir Victor Brooke's Classification—THE GAZELLE—Appearance—Habits—ARABIAN GAZELLE—PERSIAN GAZELLE—SOEMMERING'S GAZELLE—GRANT'S GAZELLE—SPRINGBOK—SAÏGA—CHIRU—THE PALLAH, OR IMPALLA—THE INDIAN ANTELOPE, OR BLACK BUCK.

THE Swine, together with those animals which most nearly approach them, namely, the Peccaries and Hippopotami, form but a small division of the cloven-hoofed order of the Mammalian animals; by far the greater number of the species of the Artiodactyla being included in a group known familiarly as that of the Ruminantia, because, as part of the digestive process, they chew the cud.

This chewing the cud is a phenomenon restricted to the group of animals now under consideration, although it may be mentioned that some naturalists have thought that the Kangaroos among the Marsupials do the same to a certain extent.

As to the details of the process, the individual, a Cow, for instance, whilst grazing, nips off the grass between the large cutting teeth in the front of the lower jaw, and the tough pad which replaces in these creatures the similarly situated teeth of the upper jaw. After each mouthful it does not proceed to masticate the food, but swallows it forthwith, and continues thus to graze until it has satisfied its appetite. Seeking a quiet and shaded spot, it then seats itself that it may ruminate, or chew the cud, at leisure. If watched it will be seen that it commences shortly to perform a slight hiccough action, in which some contraction of the flanks is to be noticed. Its mouth, which was previously empty, is found to be full of what it is not difficult to recognise to be coarsely-masticated grass, which has been forced up into it; and this it immediately proceeds to chew between its back or grinding teeth, in a slow and continuous manner, moving its lower jaw uniformly from one side to the other—from right to left. When this chewing process has lasted for a time sufficient to convert the food into a pulpy state, it is again swallowed, after which another bolus is brought up to undergo a similar operation. And this is repeated at frequent intervals until most of the food swallowed has been masticated.



STOMACH OF A RUMINATING ANIMAL: (A) EXTERIOR, (B) INTERIOR.

A complicated stomach is necessary for the operation of this elaborate chewing process, the undisturbed duration of which has led to the word by which it is designated being applied metaphorically to a brooding condition of mind. Thus the poet of the "Night Thoughts" says:—

"As when the traveller, a long day past
In painful search of what he cannot find,
At night's approach, content with the next cot,
There ruminates awhile his labour lost."

This complicated stomach is not identical in all the Ruminantia. In the Camels and the Llamas it presents many points of difference from that of all the other members of the group, and in the Chevrotains it has slight peculiarities of its own.

This organ, as found in the Ox—and it is almost identically the same in the Giraffes, the Antelopes, the Sheep, and Deer—is seen to be divided into four well-defined compartments, as represented in the accompanying figures. These are known as—

1. The Rumen, or Paunch (*b*).
2. The Reticulum, or Honey-comb Bag (*c*).
3. The Psalterium, or Manyplies (*d*).
4. The Abomasum, or Reed (*e*).

The paunch (*b*) is a very capacious receptacle, shaped like a blunted cone bent partly upon itself. Into its broader base opens the œsophagus, or gullet (*a*), at a spot not far removed from its

wide orifice of communication with the second stomach, or honey-comb bag (*c*). Its inner walls are nearly uniformly covered with a pale skin (known as mucous membrane), which is beset with innumerable close-set, short, and slender processes (known as villi), resembling very much the "pile" on velvet. It is this organ, together with its villi, which constitutes the well-known article of food termed "tripe."

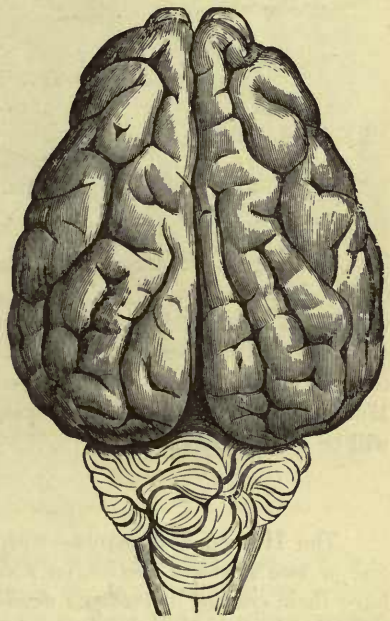
The honey-comb bag (*c*) is very much smaller than the paunch. It is nearly globose in shape, and receives its name on account of the peculiar arrangement of the ridges on the mucous membrane which lines it, these being distributed so as to form shallow hexagonal cells all over its inner surface, as seen in the figure on the previous page.

It is situated to the right of the paunch, with which, as well as with the manyplies (*d*), it communicates. Running along its upper wall there is a deep groove coursing from the first to the third stomach. This groove plays an important part in the mechanism of rumination; its nature must therefore be fully understood.

Its walls are muscular, like those of the viscus with which it is associated, which allows its calibre to be altered. Sometimes it completely closes round so as to become converted into a tube by the apposition of its edges. At others it forms an open canal.

The manyplies (*d*) is a very peculiar organ. It is globular, but most of its interior is filled up with folds, or laminæ, running between its orifices of communication with the second and fourth stomachs. These folds are arranged very much like the leaves of a book, and very close together. They are, however, not of equal depth, but form series of greater or less breadth. Their surfaces are roughened by the presence of small projections or papillæ.

The reed (*e*) is the stomach proper, corresponding with the same organ in man. Its shape is somewhat conical. The valve which partially obstructs its communication with the intestine is at the left of the foregoing figure. Its walls are formed of a smooth mucous membrane, which secretes gastric juice, and it is this stomach that, in the manufacture of cheese, is employed to curdle the milk.



BRAIN OF A SHEEP.

Whilst grazing, the possessor of this complicated stomach fills its paunch with the imperfectly masticated food, and it is not until it commences to chew the cud that any of the other parts are brought into play.

In the act of rumination, the following is the probable order of events:—The paunch contracts, and in so doing forces some of the food into the honey-comb bag, where it is formed into a bolus by the movement of its walls, and then forced into the gullet, from which, by a reverse action, it reaches the mouth, where it is chewed and mixed with the saliva until it becomes quite pulpy, whereupon it is again swallowed. But now, because it is soft and semi-fluid, it does not divaricate the walls of the groove communicating with the manyplies, and so, continuing on along its tubular interior, it finds its way direct into the third stomach, most of it filtering between the numerous laminæ on its way to the fourth stomach, where it becomes acted on by the gastric juice. After the re-masticated food has reached the manyplies, the groove in the reticulum is pushed open by a fresh bolus; and so the process is repeated until the food consumed has all passed on towards the abomasum, or true digestive stomach.

There are other features also which are characteristic of the ruminating animals. Their symmetrical four-toed feet (in which the thumb on the fore and the great toe on the hind are entirely absent) have the toes so proportioned that the axis of the limb runs down between the two middle toes at the same time that both the inside and outside toes are much reduced in size, and lost entirely in the Camel tribe, the Giraffe, and the Cabrit.

Another peculiarity which exists in all ruminating animals is the absence of cutting-teeth in the middle of the upper jaw; and it is only in the Camels and their intimate allies, the Llamas, that there are any upper cutting-teeth at all, they being replaced in all the others by a callous pad, on which the lower cutting-teeth impinge in mastication.

The canine teeth, which correspond to the tusks of the Lion and Dog, also deserve attention. Those of the lower jaw are always present, and are modified so as to appear like lateral cutting-teeth. In the upper jaw they are most often absent, but are enormous, projecting far down outside the lip, in the Musk, the Chinese Water Deer, and the Muntjacs. In some other Deer they are present, but small, and generally they are wanting.

The grinders are six on each side of each jaw, and are so formed that their surfaces wear down unevenly by the lateral movement to which they are subject during mastication. As in the Elephant, this depends upon each tooth being made up of alternate layers of enamel, dentine, and cementum, which, being of different degrees of hardness, are differently affected by the grinding action.

The ruminating animals exhibit a fair amount of intelligence, never, however, attaining that power of perception and memory exhibited by the Carnivora and other higher forms. The figure of the surface of the brain of the Sheep indicates that the convolutions of the brain are far from inconsiderable in number, and its allies of the same size agree with it in this respect, whilst larger species have more, and smaller less elaborate brain-markings, as is nearly always found to be the case in every group.

The accompanying table gives an outline sketch of the classification of the ruminating animals which has been adopted by zoologists:—

Sub-order.	*Section.*	*Division.*	*Group.*
RUMINANTIA.	TRUE RUMINANTS.	HORNED RUMINANTS.	Ox-tribe (*Bovidæ*).
			Deer-tribe (*Cervidæ*).
		CHEVROTAINS OR DEERLETS (*Tragulidæ*)	
	CAMEL TRIBE. (*Tylopoda*).		

The large sub-order of the Ruminantia is seen to be primarily divided into two sections, namely, the typical Ruminants and the aberrant Ruminants (the *Tylopoda*). The typical Ruminants, in which the stomach is formed upon the plan of that described above in the Oxen, fall into two divisions, the smaller of which—that of the Chevrotains or Deerlets—possesses no psalterium, or third stomach, except in a rudimentary condition. The Horned Ruminants, including the Deer, Muntjacs, Elk, Oxen, and Antelopes, compose by far the largest number of the whole sub-order, and will be first described.

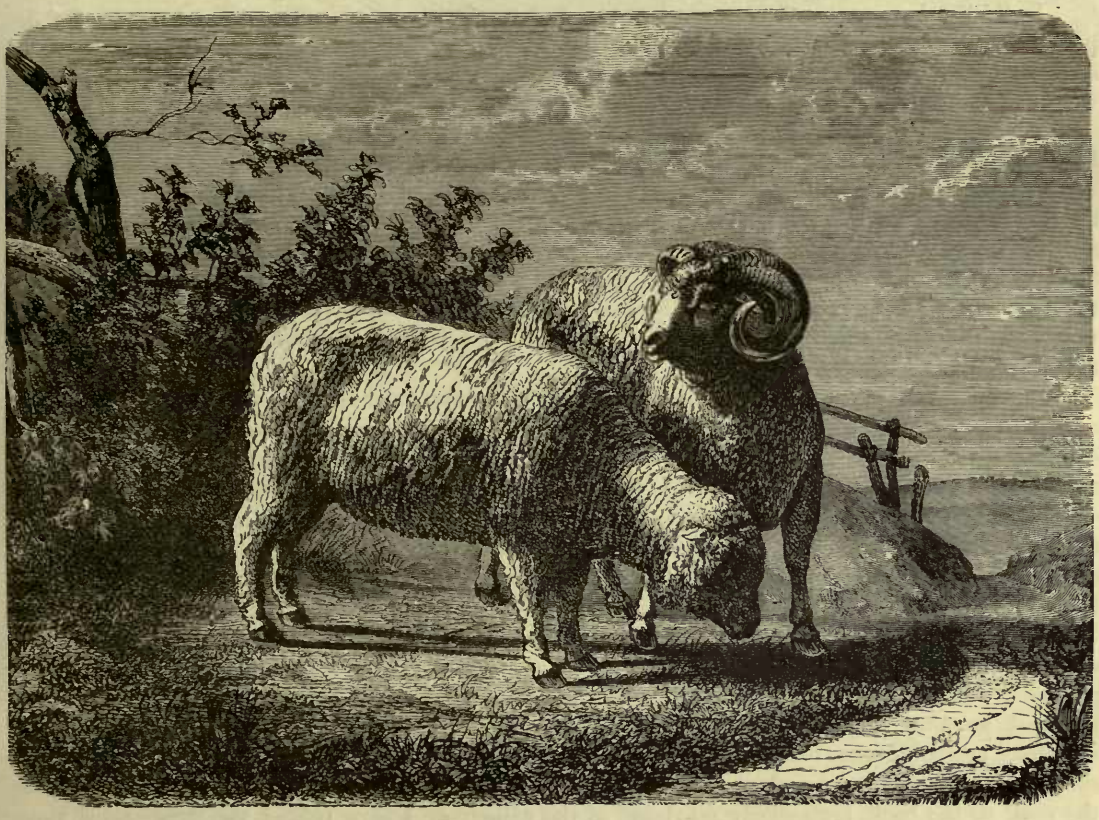
HORNED RUMINANTS.

The Horned Ruminants—with which, anomalous as it may at first seem, have to be included one or two hornless species, on account of their so closely resembling them in other respects—have their *cranial appendages developed after one or other of two principles.* In one group, which, from the fact that the Oxen are included with them, are named the *Bovidæ*, the horns are hollow, straight, or variously-twisted cones, supported upon bony prolongations from the forehead, resembling them in shape upon a smaller scale. These horns are permanent, except in the American Antelope, increasing in size each year, at the same time that they often exhibit transverse markings, which indicate the annual increase. In the other group—the *Cervidæ*, or Deer Tribe—the horns or antlers are deciduous, being cast off each year, to be shortly replaced by others, which share the fate of their predecessors. These antlers are entirely made of bone, and when fully grown are not covered with any less dense investment.

To commence, then, with the *Bovidæ*, or Oxen, and their allies.

THE BOVIDÆ, OR HOLLOW-HORNED RUMINANTS.

In these ruminating animals the permanent bone-cones on the forehead are covered with a black horny coating, which is not shed during the whole life of their owners, and in which, as they continue to grow until adult life at least, the tips are the oldest parts. The females in some species have horns like their mates, but smaller, as in the Ox and Eland; while in others—the Koodoo and the Sing-Sing Antelope, for example—the males alone are horned. The most aberrant members of this group are the Giraffe, the Cabrit, and the Musk, which will be considered after the less



MERINO SHEEP.

peculiar genera have been discussed. These include the Oxen, Bush-Bucks, Antelopes, Koodoos, Goats, Sheep, &c., which will be referred to more in detail.

THE SHEEP AND GOATS.*

Between the bearded Goat and the beardless Sheep there exist intermediate species, which so completely fill up the gaps that it is almost impossible to separate the two into different genera. With triangular, curved, and transversely-ridged horns in both sexes, a characteristic general appearance, and feet formed for mountain climbing, the species present differences which are recognised with facility.

With reference to the domestic Sheep, it is the opinion of most naturalists that it has descended from several distinct species. "Abel was a keeper of Sheep," is a Biblical statement from which the immense antiquity of a domestic breed may be inferred, whose origin cannot be better studied than by a comparison of the different forms found wild in Asia, the head-quarters of the genus. That no Sheep existed in Australia when that continent was first discovered is a well-known fact.

* The genus *Ovis*.

"Endowed by nature," as Mr. Spooner, in his work on the Sheep aptly puts it, "with a peaceable and patient disposition, and a constitution capable of enduring the extremes of temperature, adapting itself readily to different climates, thriving on a variety of pastures, economising nutriment where pasturage is scarce, and advantageously availing itself of opportunities where food is abundant," it is not to be wondered at that the animal has become the companion of man from the earliest times.

The fleece of the wild species of Sheep is composed of hair with wool at its roots, in the same way that in the Duck there is a covering of feathers and down. In the domesticated species the hair, by selection, has been reduced to a minimum, so that the wool forms the only coat.

In the southern parts of Western Asia many of the Sheep have a curious tendency to the deposition of fat on the tail rather than under the skin of the body generally, and this may occur to such an extent that the thus loaded caudal appendage may contain a large part of the entire weight of the body.

The Astracan breed, of small size, has a fine spiral black and white wool, sometimes entirely black, which is obtained from the lamb when the finest furs are required.

Of all the breeds of Sheep the Merino of Spain is one of the most important, on account of the excellence of its wool. In England the breed can hardly be said to exist, because the dampness of the climate does not suit its constitution. It is extensively found in Germany, and is *the* Sheep of Australia. The animal is small, flat-sided, and long-legged. The males have long horns, these appendages being absent in the females. The face, ears, and legs are dark, and the forehead is woolly, at the same time that the skin about the throat is lax. The body-wool is close-set, soft, twisted in a spiral, and short.

In Great Britain the breeds of Sheep are very numerous, some of the best being of quite recent origin. First among the heavy breeds are the Dishley, or Improved Leicesters, which, from their early maturity, aptness to fatten, smallness of bone, and gentle disposition, well deserve the high repute in which they stand. It is to the persevering energy and acuteness of Mr. Bakewell that we are indebted for the present animal, which in origin is far from pure bred. His aim was entirely in the direction of the carcass, and in his object he and his followers have quite succeeded, notwithstanding an inherent delicacy in constitution and an inferiority of the wool. "The head of this breed," we are told, "should be hornless, long, small, tapering towards the muzzle, and projecting horizontally forwards; the eyes prominent, and with a quiet expression; the ears thin, rather long, and directed backwards; the neck full and broad at its base, where it proceeds from the chest, but gradually tapering towards the head, and being particularly fine at the junction of the head and neck; the neck seeming to project straight from the chest, so that there is, with the slightest possible deviation, one continuous horizontal line from the rump to the poll; the breast broad and full; the shoulders also broad and round, and no uneven or angular formation where the shoulders join either the neck or the back, particularly no rising of the withers or hollow behind the situation of these bones; the arm fleshy through its whole extent, and even down to the knee; the bones of the leg small, standing wide apart, no looseness of skin about them, and comparatively bare of wool; the chest and barrel at once deep and round; the ribs forming a considerable arch from the spine, so as in some cases—and especially when the animal is in good condition—to make the apparent width of the chest even greater than the depth; the barrel ribbed well home; no irregularity of line on the back or the belly, but on the sides, the carcass very gradually diminishing in width towards the rump; the quarters long and full, and, as with the fore-legs, the muscles extending down to the hock; the thighs also wide and full; the legs of a moderate length; the pelt moderately thin, but soft and elastic, and covered with a good quantity of white wool, not so long as in some breeds, but considerably finer."

The large-sized Lincoln Sheep, with lengthy fleece, those of the Cotswold Hills, the Teeswater, and Romney Marsh, are also heavy breeds, not equal in the totality of their points to the Improved Leicesters, although excelling them either in quantity of wool or hardiness of constitution.

The Short-woolled Southdowns, with close-set fleece of fine wool, face and legs dusky brown, curved neck, short limbs, and broad body, is one of the oldest and most valuable unmixed breeds that we possess. Their mutton greatly excels that of the Improved Leicesters, which, taken in

association with their other good qualities, has caused them to extend to nearly every county. In parts of Hampshire, Shropshire, and Dorsetshire there are local breeds of Short-woolled Sheep which replace the Southdowns.

The Cheviot and the Black-faced, or Heath breed of our northern counties are mountain Sheep, of small size and hardy constitution, the former horned, the latter hornless and with a white face.

Welsh mutton is obtained from the small, soft-woolled Sheep with a white nose and face. The rams alone have horns, wherein the breed differs from that of the higher mountains, in which the ewes also are horned, at the same time that a ridge of hair is present along the top of the neck.

As wool forms so important an element of the mercantile transactions of Great Britain, and as Sheep-farming has so rapidly increased in Australia and New Zealand, a few words with reference to the statistics of the subject will not be out of place.

In 1788, when Governor Phillip landed at Port Jackson, there was not a Sheep in all Australia, and it was not until 1793 that about thirty of the Indian breed reached Sydney, their number being shortly augmented by the importation of breeding-stock from England and the Cape of Good Hope, principally Merinos. The progeny soon spread towards the interior, where the growing of wool became a lucrative pursuit. Sheep were first imported into New Zealand in 1840. It is estimated there are now one hundred million sheep in Australia, and nearly thirty million in New Zealand.

The following table of the number of bales of wool imported into Great Britain at twenty-year intervals, that is, in 1836, 1856, and 1876, gives a better idea than can be otherwise obtained as to the changes in the sources of wool as well as to the richness of each colonial district :—

IMPORTATION OF COLONIAL AND FOREIGN WOOL INTO THE UNITED KINGDOM (IN BALES).

	1836.	1856.	1876.
New South Wales and Queensland	19,066	59,342	169,874
Victoria	None	64,843	306,803
Tasmania	15,449	17,951	20,480
South Australia	None	16,618	102,067
West Australia	None	1,267	7,510
New Zealand	None	6,840	162,154
Total Australasian	34,515	166,861	768,888
Cape of Good Hope	1,740	50,607	169,908
Total Colonial	36,255	217,468	938,796
German	90,426	22,272	29,580
Spanish and Portuguese	20,451	8,106	7,906
East Indian and Persian	1,981	45,236	86,678
Russian	15,072	4,181	34,511
River Plate	16,653	5,151	118,593
Peru, Lima, and Chili		52,477	
Alpaca			
Mediterranean and Africa	14,714	13,665	
Mohair	No returns	13,515	
Sundry	12,784	10,735	
Total Foreign	172,081	175,338	277,268
TOTAL IMPORTATION	208,336	392,806	1,216,064

So much for the domestic Sheep; of other species of the genus *Ovis* we have Marco Polo's Sheep.* This splendid Sheep, one of the finest species of the genus, has horns, describing a spiral of about a circle and a quarter when viewed from the side, pointing directly outwards, and sometimes measuring as many as sixty-three inches from base to tip along their curve, and as much as four and a half feet from tip to tip. At the shoulder the animal measures just under four feet. It inhabits the high lands in the neighbourhood of the lofty Thian Shan mountains, north of Kashgar and Yarkand, not descending below an elevation of 9,000 feet above the sea level, often ascending much higher. It is

* *Ovis Poli.*

on account of the rarefaction of the air in these regions that there is considerable difficulty in obtaining specimens which have been wounded, because Horses at these heights are much distressed in their breathing, whilst the Sheep are not so. Mr. N. A. Severtzoff, an eminent Russian naturalist, has described three or four other species closely allied to Marco Polo's Sheep, which are smaller than it, from Turkestan and the district east of it. In this Sheep, during the winter, the sides of the body are of a light greyish-brown, changing to white below. There is a white mane all round the neck and a white disc round the tail. A dark line runs the whole length of the middle of the back: In summer the grey changes to dark brown.

The Oorial and the Shapoo are bearded Sheep, from Ladakh and the Suliman range of the

AMMON.

Punjab respectively, with large horns, which form not more than half a circle in the Shapoo and nearly a complete one in the Oorial. The colour of the Oorial is a reddish-brown above, paler beneath, the abdomen being white. A lengthy dark beard, reaching to the knees, fringes the whole length of the neck from the chin to the chest. The points of the horns are directed inwards. It is found at altitudes of 2,000 feet. The Shapoo is brownish-grey, white below, with a short brown beard. Its horns turn outwards at the tips. It is never found at altitudes lower than 12,000 feet.

The Mouflon at one time abounded in Spain, but is now restricted to the islands of Corsica and Sardinia. The species is a small one, of a brownish-grey colour, with a dark streak along the middle of the back, at the same time that there is a varying amount of white about the face and legs. The horns, present in the males only, are proportionately not large, curve backwards and then inwards at the tips. The tail is very short, in which respect they differ strikingly from the domestic Sheep, to which otherwise they are intimately related. The Mouflon frequents the summits of its native hills

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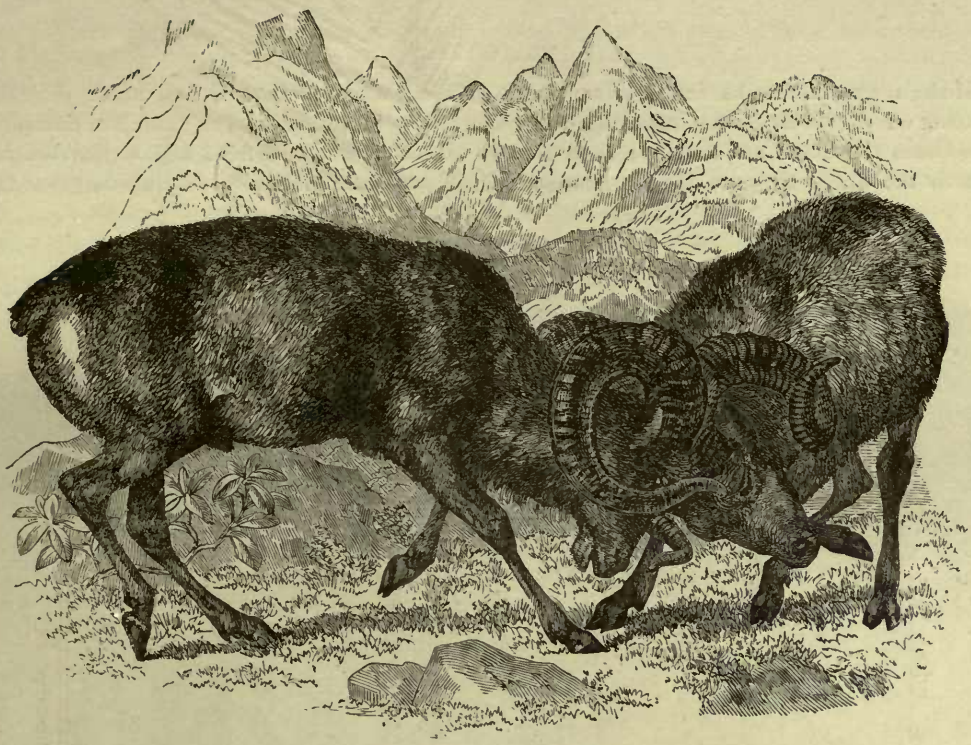


AMMON.

in small herds, headed by an old ram. Its skin is used by the mountaineers for making jackets. It breeds freely with the domestic species.

The AMMON of Tibet has been known to measure as much as four feet and an inch at the shoulder, and has a most imposing appearance on account of the erect attitude in which it holds its head. Its horns attain a great size, being sometimes as much as four feet long and twenty-two inches in circumference at their bases, forming a single sweep of about four-fifths of a circle, their points being turned slightly outwards and ending bluntly. Its body colour is dark brown above, paler posteriorly and below. A mane surrounds its neck, white in the male, dark brown in the female. The tail measures only an inch in length. In the female the horns do not exceed twenty-two inches in length.

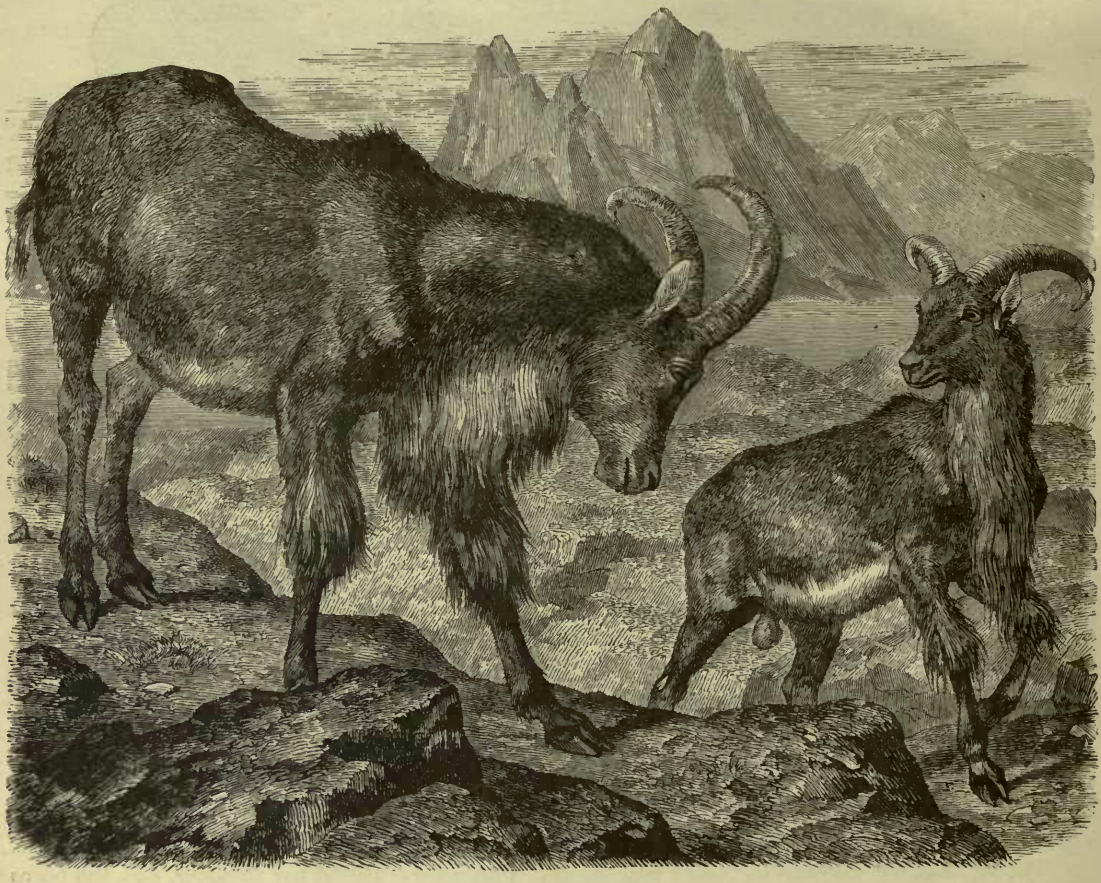
The BURHEL, or Himalayan "blue wild Sheep," stands three feet at the shoulder, and has horns which, commencing very close together on the forehead, describe a half circle of two feet or so, and are directed very much outwards and backwards. In the female the horns do not exceed eight inches in length, and stand backward instead of diverging. The coarse fleece of winter is of an ashy-blue colour, which, in summer, is replaced by one that is much darker. The abdomen is white, and a black stripe runs along each side of the body, the front of the legs and the chest being also black. It has no beard.

The AMERICAN ARGALI, or BIG-HORN, inhabits the range of the Rocky Mountains. Its height is three and a half feet at the shoulder. The horns form a complete circle, and are nearly three feet long in the male. They are said to come so far forward and downward that old rams find it impossible to feed on level ground. Its flesh is peculiarly well flavoured.

The WILD SHEEP OF BARBARY, known also as the TRAGELAPHUS, is a large and handsome species, with a comparatively lengthy tail, tufted at its end. The hair on the chin is short, whilst that along the lower margin of the neck, as well as on the front of the knees, attains a great length. The horns are not massive, and hardly exceed two feet in length. They are black, and are directed outward as well as backward.

THE GOATS.*

Modern naturalists, as intermediate forms become more numerous, find much difficulty in separating off the Goats (which constitute the genus *Capra* of earlier authors) from the Sheep (*Ovis*). In the Goats the horns are flattened from side to side, and rough in front and arched backwards, whilst in the Sheep they are more uniformly cylindrical, turned laterally, curling downwards, and



BARBARY WILD SHEEP.

often cork-screwed. A beard is a common addition to the former animal, and a most unpleasant odour is emitted by them.

The domestic Goat is almost certainly descended from the Paseng, or Ibex, of the mountains of Asia, with little or no admixture of other blood. In it, however, the female is bearded as well as the male, which is not the case with the Paseng. It has been subjugated from time immemorial, when the flesh of the kid was considered a delicacy. Its sure-footedness and its boldness are proverbial, as is its unpleasant odour. The power possessed by the species of ascending precipitate heights is marvellous. On more than one occasion it has been recorded—contrary to the teaching of Æsop—that whilst two individuals have met on a path too narrow for both to pass, one has lain down in order that the other might go over its back. With no great bulk of body; coarse hair of different lengths and tints, springing from out of a mass of much shorter wool; horns of varying size, but always out-turned at the tips; narrow ears, an almost entirely hair-covered nose; sight, hearing, and smell all acute; powerful thick-set legs, and a short tail naked below, it stands its own in mountainous and less civilised

* The genus *Capra*.

districts. Varieties occur with large pendulous instead of upright ears; others with extra horns, occasionally spiral as in Nepaul, or none at all. In the Angora and Cashmere breeds the hair is white.

The Goat of Cashmere is famous on account of the long and very fine wool with which it is covered, which is employed in the manufacture of Cashmere shawls. It is said that the wool of ten of these Goats is required for the material of a single shawl.

The IBEX is found in the Alpine heights of Europe and of Western Asia, including the Himalayas. The large scythe-blade-shaped horns of the male curve boldly upwards and backwards, diverging all the way. Along the front of their convex surfaces there is a series of protuberances or partial rings, which are only just indicated laterally. The largest specimens reach three feet

IBEX.

and a half in height at the shoulder, which is a little less than the length their horns sometimes attain. The body colour is a yellowish-grey, white below, with a dark brown line along the middle of the back. The soft and close-set hair hides an under-fur still finer. The beard is black. European specimens are smaller than those from Asia, rarely exceeding two feet and a half in height, with horns three feet in length. The species inhabits the most precipitous and dangerous parts of mountain regions, and is wonderfully sure-footed.

The PASENG is the wild Goat of Western Asia; it is also found on the northern side of the Caucasus and in some of the islands of the Ægean. In height the male measures two feet and three-quarters at the withers, the female being nearly six inches less. In the male the horns may measure as much as four feet in length. They are flattened, slender, curved backwards as part of a large circle, having their points turned sometimes inwards, so much so as now and again to cross, whilst at others they are directed outwards. Along their anterior edges are protuberances, separated by a greater distance as they approach the tips, indicative of the age of the animal, as after the third year a

fresh knob is formed in each succeeding one. Mr. Danford, who has made a special study of the species, remarks, with reference to the reputed use to which their owners turn their immense cranial appendages, that "regarding the use of the great horns carried by the Ibex family, the general idea among the older authors was that they were employed to break the animal's fall in leaping from a height. Pennant relates that Monardes was witness to the wild Goat saving itself in this way; and Gesner says: 'Cadens ab alto totum corpus inter cornua protegit a collisione et ictus lapidum magnorum excipit cornibus!'* This view is confirmed by Mr. Hutton, whose tame Aegagrus [Paseng] repeatedly used his horns for this purpose. I made many inquiries among the native hunters, and they all agreed

MARKHOOR.

in saying that the horns were never so used, or for any purpose except fighting; and the result of my own observations is, that during the leap the head is carried as far back as possible, though it may be that the situations in which I observed the animals did not necessitate the employment of the horns in the way referred to." The horns of the female are not more than a foot long, the knobs being almost obsolete. Unlike its consort, also, it has no beard. The general colour of the species is grey, shaded with reddish-brown. A blackish-brown line extends from the similarly coloured forehead along the spine.

The MARKHOOR, or "Serpent Eater," of North-east India and Cashmere, is a fine Goat of larger size than the Ibex, with much-flattened triangular horns, which, while running upwards from the head, are spiral and attain an immense size, sometimes as much as five feet along their curve. The spiral twist is much more open in some specimens than in others, depending on the locality in which they are found. The body colour is a dirty light blue-grey, the lengthy beard being of a darker colour. It inhabits very similar localities to the Ibexes and is very shy.

The TAHR of the Himalayas is a not common Goat, with small horns curved directly backwards,

* "Falling from a height, it protects its whole body, between its horns, from shock, and receives upon its horns the concussion of the huge stones."

not much more than a foot in length, flattened from side to side, with a notched anterior margin. The body colour is a fawn-brown; the hair of the neck, chest, and shoulders being of great length and reaching to the knees. In the female the horns are much smaller and of lighter colour. According to Captain Kinloch, "the Tahr is, like the Markhoor, a forest-loving animal, and although it sometimes resorts to the rocky summits of the hills, it generally prefers the steep slopes which are more or less clothed with trees. Female Tahr may be frequently found on open ground, but old males hide a great deal in the thickest jungle, lying during the heat of the day under the shade of trees or overhanging rocks. Nearly perpendicular hills, with dangerous precipices, where the forest consists of oak and ringall cane, are the favourite haunts of the old Tahr, who climb with ease over ground where one would hardly imagine that any animal could find a footing. Tahr ground, indeed, is about the worst walking I know, almost rivalling Markhoor ground; the only advantage being that, bad as it is, there are generally some bushes or grass to hold on to."

THE GAZELLES.*

Under the title of Gazelles are included several strikingly elegant, small, slender, sandy-coloured species of ruminating animals, in which the males always, and the females in most cases, carry horns, which are transversely ringed, and vary considerably in the direction which they take, many having them curved in such a way that the two together form a lyre-shaped figure, at the same time that in others they are nearly straight, turned slightly backwards or forwards, and diverging or converging at the tips. Where present, the horns of the females are more slender than in the corresponding males.

The Gazelles inhabit Africa, Arabia, Persia, India, and Central Asia only. They rarely exceed thirty inches in height at the shoulder; the largest, the Swift Antelope of Pennant (*Gazella mohr*), reaching nearly three feet. In all the Gazelles the face is marked with a white band running from the outer side of the base of each horn nearly down to the upper end of each nostril, cutting off a dark triangular central patch, and bordered externally by a diffused dark line. The under surface of the abdomen is white, and there is a dark line traversing the flank which bounds this. The rump is also white, which in many cases encroaches more or less upon the haunches.

Of the twenty species of Gazelles known to naturalists, only a few of the best known will be specially mentioned here. By Sir Victor Brooke they have been thus arranged, in accordance with certain easily ascertained distinctive features in coloration and shape of horn :—

I.—BACK UNSTRIPED.

A. *The white colour of the rump not encroaching on the fawn colour of the haunches.*

a. Both sexes bearing horns.

1. Horns Lyrate or Semi-Lyrate.

The Gazelle (Arabia and N.E. Africa).
Isabelline Gazelle (Kordofan).
Korin (Senegal).
Sundevall's Gazelle (Sennaar).
Black-tailed Gazelle (Bogosland).

2. Horns not Lyrate.

Cuvier's Gazelle (Morocco).
Small-horned Gazelle (Senaar).
Speke's Gazelle (Somali Country).
Muscat Gazelle (Muscat).
Arabian Gazelle (S. Arabia).
Bennett's Gazelle (India).
Dusky-faced Gazelle (Persia).

b. Females horniess.

Persian Gazelle.
Mongolian Gazelle.
Ladakh Gazelle.

B. *The white colour of the rump projects forward in an angle into the fawn colour of the haunches.*

Dama Antelope (S. Nubia).
Swift Antelope (Senegal).
Soemmerring's Antelope (E. Africa).
Grant's Gazelle (Ugogo).

II.—BACK WITH A MEDIAN WHITE STRIPE.

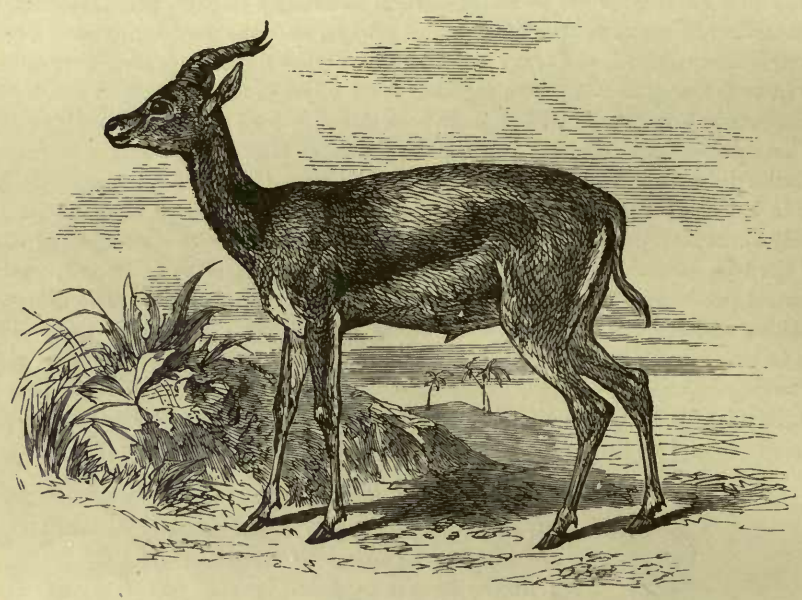
Spring-bok (S. Africa).

The Gazelle *par excellence*, from Syria, Egypt, and Arabia, stands scarcely two feet high. The elegance of its proportions are too well known to need description. The beauty of its eyes is not to be

* The genus *Gazella*.

compared with that of some of the other ruminating animals, the whole face being far too sheep-like, and this remark equally applies to all its near allies. The Dorcas Gazelle is a name by which it is also known. Like many other members of the genus, it has a tuft of hair upon each knee. The tail is long and tapering; the body hair rather coarse and of a pale fawn colour. The hips, as well as the breast and the abdomen, are white. As to their habits, Mr. Blanford, in his work on Abyssinia, tells us that, so far as his observation went, "neither the Dorcas nor Bennett's Gazelle is ever seen in large flocks, like the animals of the Spring-bok group. Usually both are seen solitary, or from two to five together, inhabiting thin bushes generally on broken ground. They feed much upon the leaves of bushes. The male has a peculiar habit, when surprised, of standing still and uttering a short, sharp cry. Like most Antelopes, they keep much to the neighbourhood of some particular spot. After long observation, I am convinced that Bennett's Gazelle never drinks; and all that I could ascertain of the Dorcas Gazelle leads to the same conclusion in its case."

Captain Baldwin says that, "like other Antelopes, the little Ravine Deer [by which is meant



DORCAS GAZELLE.

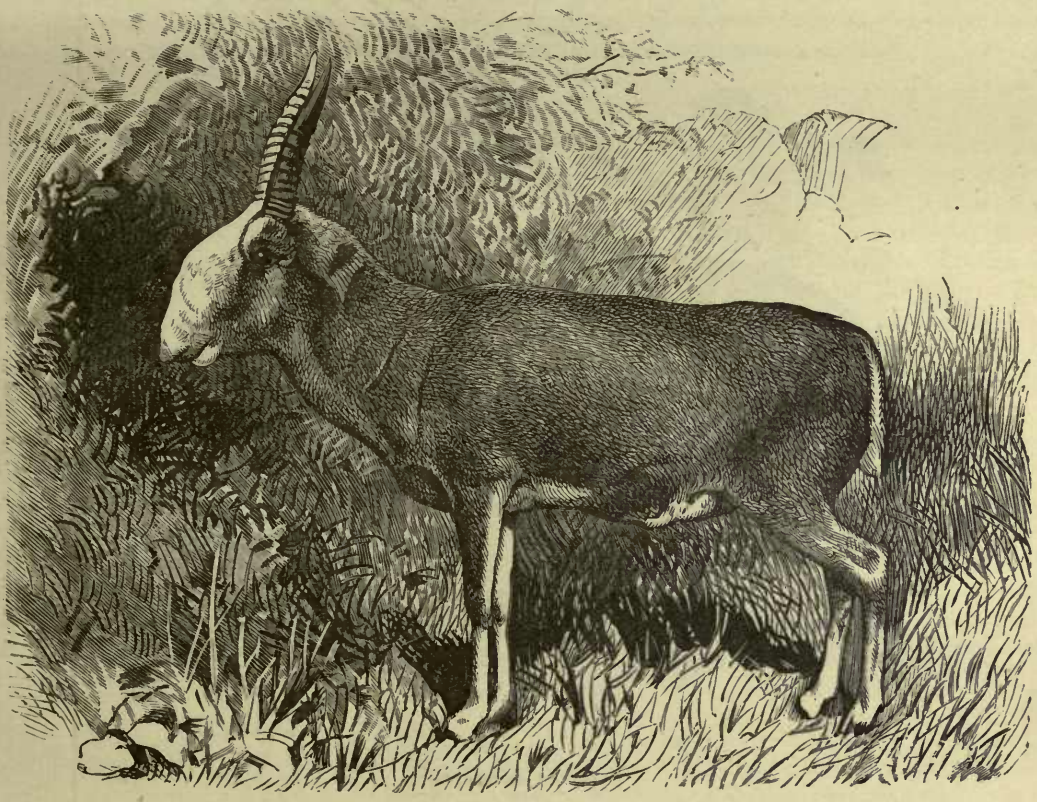
Bennett's Gazelle] has many enemies besides man. One day, when out with my rifle, I noticed an old female Gazelle stamping her feet, and every now and then making that 'hiss' which is the alarm-note of the animal. It was not I that was the cause of her terror, for I had passed close to her only a few minutes before, and she seemed to understand by my manner that I meant no harm. No; there was something else. I turned back, and on looking down a ravine close by, saw a crafty Wolf attempting a stalk on the mother and young one. Another day, at Agra, a pair of Jackals joined in the chase of a wounded Buck.

"The Chikarah [again another name for Bennett's Gazelle] is as easily tamed as the common Antelope; they are favourite pets, and become strongly attached to those who rear and feed them. I have seen tame ones driven out with a herd of Goats to graze, and never attempt to make their escape. It is not at all unusual to find the wild Gazelles feeding close to, sometimes almost mingling with, herds of Goats, when the latter have been driven out to pasture. . . . . Like all Antelopes, the eyesight of the Chikarah is very acute, and the animal is perpetually on the watch against danger. It, however, appears to be gifted with only a moderate sense of hearing, and still less so of smell."

The Arabian, or Arid Gazelle, is the same size as the preceding, differing, as may be gathered from the table given on page 13, in the shape of its horns, which, from being directed upwards and

outwards, turn at their tips more outward and also forward. The speed of the Gazelle, like that of most of its allies, is very great; its eyes are large and lustrous, and its general colour a rich yellowish-brown.

The PERSIAN GAZELLE stands twenty-six inches. Its body colour is grey fawn colour, the breast and abdomen being white. Of its habits, Major St. John says that, "like the wild Ass, it especially affects the neighbourhood of the salt deserts. It appears to retire generally to the valleys at the base of hills to breed, and is most commonly seen in small parties of three to half a dozen. The fleetest Greyhound cannot come up with the Gazelle when it gets a fair start; but when suddenly roused from a hollow, or when the ground is heavy after rain, good Dogs will often pull down males. The does are more difficult to catch."



SAÏGA.

SOEMMERRING'S GAZELLE stands two feet and a half high. The body colour is sandy fawn above; the horns are massive and lyrate, more slender in the female. It lives in pairs, and is a powerful species.

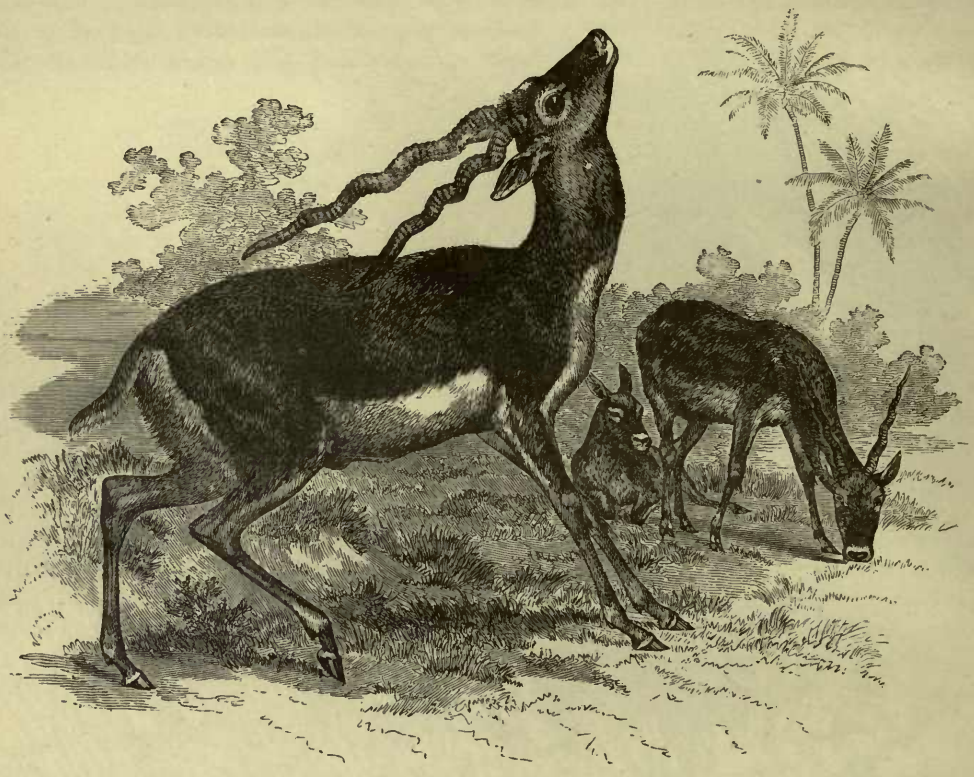
The horns of GRANT'S GAZELLE are larger than in any other of the species.

The SPRING-BOK derives its name from the habit it has of leaping straight up in the air for several feet when alarmed or whilst running. Its height is two feet and a half. The horns are lyrate, being very small in the females. Its colour is yellow dun, with the under parts, as usual, white. A peculiar white line along the middle of the back can be varied in extent within certain limits by the animal at pleasure. Major C. Hamilton Smith, when writing of this species, tells us that it assembles in South Africa in vast herds, "migrating from north to south and back with the monsoons. These migrations, which are said to take place in the most numerous form only at the interval of several years, appear to come from the north-east, and in masses of many thousands, devouring, like locusts, every green herb. The Lion has been seen to migrate and walk in the midst of the compressed phalanx, with only as much room between him and his victims as

the fears of those immediately around could procure by pressing outwards. The foremost of these vast columns are fat, and the rear exceedingly lean while the direction continues one way; but with the change of the monsoon, when they return towards the north, the rear become the leaders, fattening in their turn."

The SAÏGA* and CHIRU† differ from the Gazelles but slightly, and approach the Sheep; the former belonging to Eastern Europe and Western Asia, the latter to Tibet.

The Saïga is as large as a Fallow Deer, tawny yellow in summer, light grey in winter; being specially peculiar about the nose which is much lengthened, at the same time that the nostrils are expanded to such a degree that in feeding they have to walk backwards. The horns, found only



INDIAN ANTELOPE.

in the males, are not a foot long, slightly lyrate, and annulated. In its native haunts—which are barren, sandy, and salt—it assembles frequently in vast herds. It runs rapidly when pursued, but is soon exhausted.

The CHIRU is slightly smaller, of a reddish fawn colour, with the face and front of the limbs black. The slender jet-black horns, very small in the female, are ringed nearly to the tips, curved forward, and about two feet long. From Captain Kinloch's account we learn that "in the early part of the summer the Antelope appears to keep on the higher and more exposed plains and slopes where snow does not lie; as the season becomes warmer, the snow which has accumulated on the grassy banks of the streams in the sheltered valleys begins to dissolve, and the Antelope then comes down to feed on the grass which grows abundantly in such places, and then is the time that they may most easily be stalked and shot. They usually feed only in the mornings and evenings, and in the day-time seek more open and elevated situations, frequently excavating deep holes in the stony plains in which they live, with only their heads and horns visible above the surface of the ground."

* *Saïga tartarica.* † *Panthalops Hodgsoni.*

THE PALLAH.*

THE PALLAH, OR IMPALLA, of South and South-east Africa, is another closely-allied form of large size, being more than three feet high at the shoulder. Its colour is dark red above, yellow dun on the sides, and white below. There are no false hoofs in the usual situation on the lengthy legs: a peculiarity which it shares with the Cabrit and the Giraffe. The eyes are very large and liquid. The horns, wanting in the female, are twenty inches long in the male, and lyrate; they are ringed nearly to their tips. They are abundant on or near to hills, and collect in herds of from twenty to thirty. Mr. Drummond, vividly describing his South African experience, on an occasion whilst hunting Buffalo, "saw something red moving among the trees, and stopped to watch it. It turned out to be a troop of Impalla coming back from water and making for some of the grassy glades. There might have been seventy or eighty of them, picking their way along in Indian file, nibbling here and there, but always moving, and seeming like a troop of ghosts in the dim twilight and silence."

THE INDIAN ANTELOPE.†

THE INDIAN ANTELOPE, OR BLACK BUCK.—This species differs but little from the Gazelles in many respects, whilst its peculiarities are striking. Like the Nylghau, the male differs greatly from the female in its colour. The female has no horns; those in the male are black and of great size, spirally twisted for three or four turns like a corkscrew, slightly divergent, and often reaching thirty inches in length. It stands a little over two feet and a half at the shoulder. The colour of the males is deep brown-black above, with an abrupt line of separation from the pure white of the belly. This dark colour extends down the outer surface of each limb. The face is also black, with a white circle round the eyes and nose. In the females and young of both sexes the black and brown are replaced by a light fawn colour. The tail is very short and white below. At certain seasons of the year the glands below the eyes are much enlarged and form a prominent feature in the face of the male.

The Black Buck is one of the swiftest of the Antelopes, no Greyhound having any chance against it. Its flesh, being dry and unsavoury, is rarely eaten. The species falls a frequent prey to the Tiger, and is generally found in herds, fifty does, or so, accompanied by a single buck. The height to which they can bound is very great. According to Major C. Hamilton Smith, the native Indians "have raised the common Antelope among the constellations, harnessed it to the chariot of the moon, and represented it as the quarry of the gods. In the opinion of Hindoos the animal is sacred to Chandra, female devotees and minstrels lead it, domesticated, by the harmony of their instruments, or the power of their prayers, and holy Brahmins are directed to feed upon their flesh, under certain circumstances prescribed by the *Institutes of Menu.*"

CHAPTER II.

RUMINANTIA: BOVIDÆ (*continued*)—ANTELOPES.

THE STEINBOKS: KLIPSPRINGER, OUREBI, STEINBOK, GRYSBOK, MADOQUA—THE BUSH-BUCKS—Appearance—Distinctive Marks—THE FOUR-HORNED ANTELOPES—Peculiarity in the Chikarah—THE WATER ANTELOPES: NAGOR, REITBOK, LECHÈ, AEQUITOON, SING-SING, WATER-BUCK, POKU, REH-BOK—THE ELAND—Beef—Appearance—Captain Cornwallis Harris' Description—Hunting—Scarcity—THE KOODOO—Appearance—King of Antelopes—ANGAS' HARNESSED ANTELOPE—THE HARNESSED ANTELOPES: GUIB—BUSH BUCK, OR UKOUKA—Appearance—Pluck—THE BOVINE ANTELOPES—THE BUBALINE—HARTEBEEST—BLESBOK—BONTEBOK—SASSABY—THE GNU—Grotesque Appearance—Habits—BRINDLED GNU—THE CAPRINE ANTELOPES—SEROW—Ungainly Habits—GORAL—CAMBING-OUTAN—YAKIN—MAZAMA—THE CHAMOIS—Distribution—Appearance—Voice—Hunted—THE ORYXES—BLAUBOK—SABLE ANTELOPE—BAKER'S ANTELOPE—ORYX—BEISA—BEATRIX—GEMSBOK ADDAX.

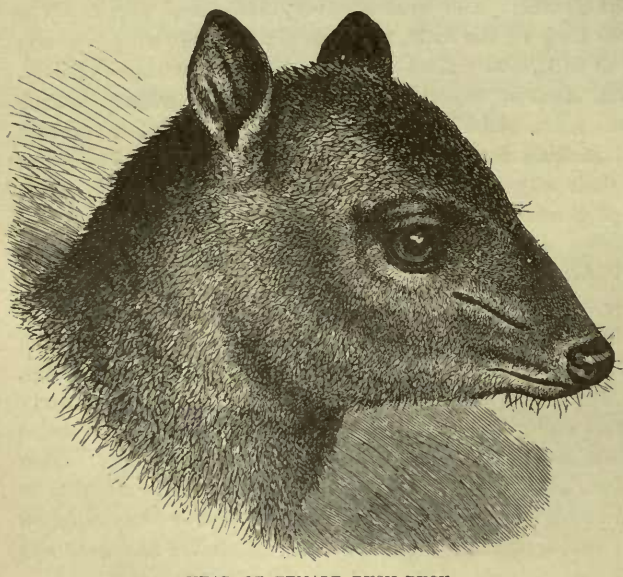
THE STEINBOKS.

THE KLIPSPRINGER, the OUREBI, the STEINBOK, and the GRYSBOK form a small section of the African Antelopes, elegant and small, with horns only in the males, these being straight, or nearly so. Their body hair is harsh. The Klipspringer stands a little under two feet high; it is the heaviest in build

* *Æpyceros melampus.* † *Antilope bezoartica.*

of the four; its horns are four inches long and curved a little forward. Its colour is olive. It lives singly or in pairs, in mountainous districts, and it was at one time so abundant in the neighbourhood of the Cape of Good Hope that its hair was employed to stuff saddles with.

The Ourebi, in height and length of horn, resembles the last-mentioned species. Its build is very delicate, its general colour being a tawny yellow, white below. Its speed is very great. According to Mr. Drummond, "its peculiar colour so much resembles the soil on which it lies that, trusting to remain unobserved, it often allows you to get within fifteen or twenty yards of where it is squatting. It is a handsome and peculiarly graceful Antelope, extremely good eating, and well worth the hunter's attention. One thing he should bear in mind is, that however slightly they may be wounded, they will go and lie down within a few hundred yards, if not chased by a Dog, and will in such cases very generally allow him to get within shot again." The Steinbok is twenty inches high, with straight horns four inches long, large ears, and a mere stump of a tail. Its colour is red-brown, white below.



HEAD OF FEMALE BUSH-BUCK.

The Grysbok, with the same measurement, is chocolate-red.

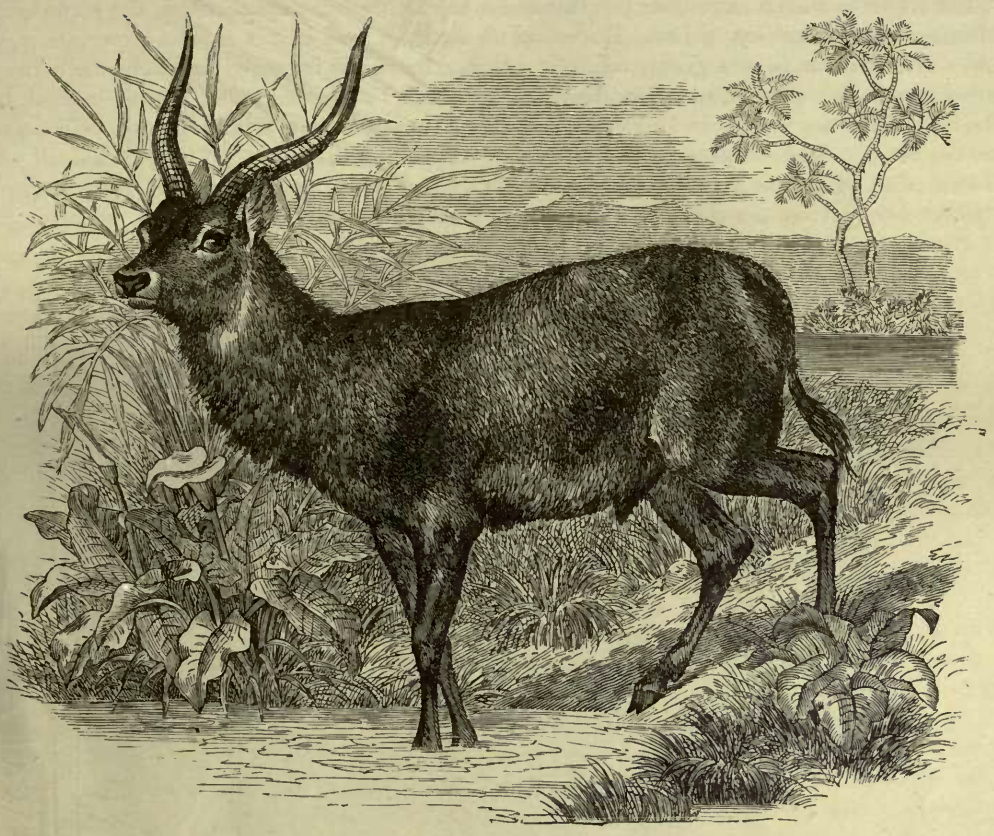
The MADOQUA of Abyssinia is not bigger than a Hare, standing fourteen inches high, the slender legs being comparatively long. The horns, present only in the males, are not more than half the length of the head, being nearly straight, and curved a little forward. The tail is a mere stump. The back is reddish-brown, the sides grey; the face, together with a peculiar tuft between the horns, is red, as are the legs. The under parts are white.

THE BUSH-BUCKS.*

The Bush-bucks form a clearly-defined group of small Antelopes peculiar to tropical and Southern Africa. They are also known by sportsmen as Duykers, or Bush-goats. They are characterised by the possession of horns in the male sex, which are short, straight, and simple cones, very much depressed, or slanting backwards, and rising some distance behind the eyes; at the same time that there is a tuft of lengthy hair, directed backwards, which is arranged in a kind of horseshoe shape between the ears. The crumen or gland in front of each eye is also peculiar. Instead of it being a sac with a circular opening, it is spread out in the form of a curved line, and not contracted to form an orifice at all. This feature, which is not observed in any other animal, may be seen in the drawing of the head of the female Bush-buck. The muffle, or extremity of the nose, is much like that of the Ox, comparatively large and always moist. The tail is very short, whilst the ears are of a fair size and oval in form. The legs are particularly slender and delicate, terminated by minute hoofs. In most the forehead is strongly convex. The coloration of the many species is not striking, being a uniform red-brown, dark bluish-grey, or sooty-black. The smallest of the species, the Pigmy Bush-buck, is not bigger than a Rabbit, and might at first sight, especially the female, be mistaken for a Deerlet. According to Mr. Drummond, "it feeds principally on certain berries and shrubs found growing in the jungles, and seems to be on the move, more or less, the whole day, though, in common with the rest of the animal creation, it is most often to be seen at early morning and evening."

Of the Bush-bucks, the Philantomba, of West Africa, is grey-brown; the Blau-bok, of Southern Africa, a bluish-grey; the Duyker-bok, of South Africa, a yellowish-brown; the Coquetoon, a deep

* The genus *Cephalophus*.



WATER-BUCK.

reddish-bay; the Bay Antelope, of West Africa, a dark bay, whilst there are other species black, brown, &c.

THE FOUR-HORNED ANTELOPES.*

In India and Tibet there are two peculiar species of small Antelopes, the true Four-horned and the Brown Indian Antelope. In the former of these, known also as the Chikarah, different from what is found as a natural condition in any other living animal, there are two pairs of well-developed horns; the hinder, which are the larger, being five inches long, in the usual situation; the smaller, an inch and a half long, are close together not far behind the eyes. In the Brown Indian Antelope the anterior pair of horns are rudimentary, and nothing more than knobs. All these horns are straight and conical. Neither species is common. Their size is about that of the Arabian Gazelle; their colour a reddish-brown, becoming lighter below; the hair is coarse; the female is hornless. Captain Kinloch says of them that "four-horned Antelopes are generally found alone, or frequently in pairs; they conceal themselves in long grass or among low bushes, and somewhat resemble hares in their habits. They are seldom to be seen out feeding, but usually jump up at the feet of the hunter and bound away at a great pace."

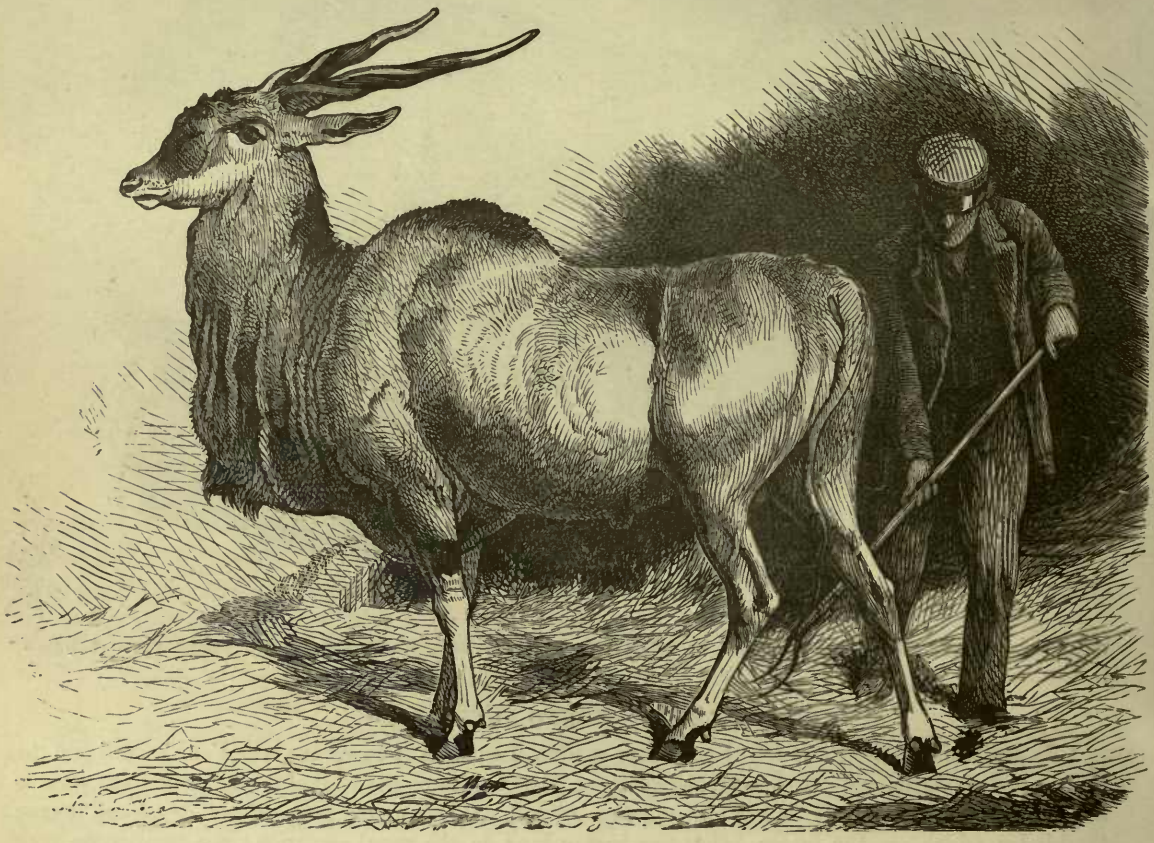
THE WATER ANTELOPES.†

The NAGOR, the REITBOK, the LECHÈ, the AEQUITOON, the SING-SING, and the WATER-BUCK are closely allied African Antelopes, with good-sized horns (only present in the males), which are transversely wrinkled, curved forwards, and a little inwards at the tips. Most of them are water-loving animals, and abound in marshy districts on the banks of rivers.

* The genus *Tetraceros*.

† The genus *Eleotragus* and its allies.

The Nagor is a little more than two feet and a half in height at the shoulder, the horns being six inches long, and the tail ten inches. The colour of the long, loose hair is fulvous-brown above, white below. The Reitbok is of a grizzly ochreate colour. Its height is nearly three feet, the horns being twelve inches long. According to Dr. Kirk, the species is "commonly found feeding in small herds; in the heat of the day it rests in long grass, and may be approached within fifty yards before starting. It seldom runs far without stopping to look round. Before again making off it gives a shrill whistle, as it does often when first started. Should the female have young unable to run far, and danger near, she places her foot on the shoulder and presses it to the ground; after which it never moves



ELAND.

until almost trodden upon, and is expected to remain in the same spot until the return of the mother." The Lechè is of a pale brown colour above and white below. Sir John Kirk says it "is a water Antelope, frequenting damp, marshy places, and taking to impassable swamps, among reeds and papyrus. It goes in considerable herds, accompanied by several males, mingling often with the 'Poku,' another Antelope peculiar to that region (the valley of the Zambesi). In the distance the Lechè may be known by the peculiar way in which it allows its horns to recline back, almost touching the withers." The Poku, Vardon's Antelope of Livingstone, is smaller than the Lechè, and thicker in the neck; otherwise it closely resembles it.

The Sing-sing Antelope and Water-buck are much alike, the former wanting a white elliptical patch, which is found near the base of the tail in the latter. The body colour is a greyish-brown. Long hair on the neck produces a mane. At the shoulder they stand four feet six inches, and the pale horns are two feet and a half long. "The Water Antelope," says Mr. Drummond, "is an extremely fine animal, and so plentiful that there are, perhaps, more of them shot than of any of the other large Antelopes. The large ringed horns which, in the male, crown its brow, bear a strong resemblance to

those of the Reedbuck [Reitbok], while the habits and general appearance of both species are almost identical. Both frequent thickets and reedy places near water, and are principally found in pairs or small groups. The hair of the species [of Water-buck] inhabiting Eastern Africa is very long and coarse, though that of the one found in Central Africa [the Sing-Sing] is remarkably soft, and is highly prized by the natives as being so."

The Reh-bok of South Africa, "though almost approaching a Fallow Deer in size, more nearly," says Mr. Drummond, "resembles a Chamois in other particulars; indeed, it has been called the African Chamois, and so far deserves the title, that it certainly possesses many of the characteristics and habits of the European species—decidedly more so than any other of the Antelope genus found in South Africa, with the exception of the Klipspringer. Their colour is light grey, the hair being somewhat long and coarse, and the horns are straight [bent forwards at the tips], and by no means unusually large for the animal's size. They are never found but on the bare hills, among rocks and stones, and their powers of springing are wonderful. It seems extraordinary how their delicate limbs escape injury, when they take bound after bound like an indiarubber ball, in places that a Cat would shudder at." According to Major C. H. Smith, "it is an animal of great swiftness, moving with wonderful rapidity by lengthened stretches, close to the ground, so as to seem to glide over the desert like a mist driven by the winds, and, favoured by the indistinct colours of the fur, is immediately out of sight. The Bushmen and western tribes [of South Africa] make lance-heads, awls, and other tools of the horns, and occasionally cloaks of their skins for the women."

THE ELAND.*

This fine species attains to the size of an Ox, the bull standing six feet and a half at the withers. Attempts have within the last few years been made to breed it in England for the sake of its flesh, which is as good as the best beef. It is, however, found to be impossible to get the price sufficiently low for market purposes. Two varieties are known, one of a pale fawn colour from Central Africa, the other, from South Africa, of a bright yellow tan colour, marked transversely with narrow white lines, about fifteen in number, running from a black line which goes along the back, to the belly. These marks are present in all young individuals, and disappear or fade considerably in the adults. The full-grown bull has a broad tuft of lengthy slight brown hair on the forehead, between and in front of the horns, which are situated some distance behind the eyes, being straight, a foot and a half in length, and at their bases carrying a thick and conspicuous screw-like ridge which extends in some cases nearly to their ends. In the females the horns are never quite so large as in the males. A large dewlap hangs from the throats of the bulls, whilst a dark, short mane continues from the forehead backwards. The tail is about two feet and a quarter in length, with a large tuft of brown hair at its end.

According to Captain W. Cornwallis Harris, "in size and shape the body of the male Eland resembles that of a well-conditioned Guzerat Ox, not unfrequently attaining the height of nineteen hands, and weighing two thousand pounds. The head is strictly that of an Antelope, light, graceful, and bony, with a pair of magnificent straight horns, about two feet in length, spirally ringed, and pointed backwards. A broad and deep dewlap fringed with brown hair reaches to the knee. The colour varies considerably with the age, being dun in some, in others an ashy blue with a tinge of ochre; and in many also sandy-grey approaching to white. The flesh is esteemed by all classes in Africa above that of any other animal; in grain and colour it resembles beef, but is better tasted and more delicate, possessing a pure game flavour, and the quantity of fat with which it is interlarded is surprising, greatly exceeding that of any other game quadruped with which I am acquainted. The female is smaller and of slighter form, with less ponderous horns."

When writing on the hunting of these creatures, known in South Africa as the *Impoofo*, the same author remarks that, "notwithstanding the unwieldy shape of these animals, they had at first greatly exceeded the speed of our jaded horses, but being pushed they soon separated; their sleek coats turned first blue and then white with froth; the foam fell from their mouths and nostrils, and the perspiration from their sides. Their pace gradually slackened, and with their full brilliant eyes turned imploring towards us, at the end of a mile, each was laid low by a single bullet."

* *Oreas canna.*

With reference to these animals, the Hon. W. H. Drummond tells us that "more Eland are killed from horseback than on foot; for as it is utterly out of the question to make a practice of running them down, and as they generally inhabit the treeless flats, where they cannot, except by chance, be stalked, while the uncertainty of their movements and their keeping out of cover render it impossible to find them, like the large animals, by the aid of their spoor, some more certain method is needed than the chance meetings which occur to the hunter when in pursuit of other game, more especially as their hide is held in great repute by the Dutch colonists, who make trek-tows for their wagons, and reins for their oxen from it, even preferring it to that of a Buffalo. The demand thus induced has so diminished their numbers as to have restricted this noble Antelope to a few favoured localities, even in which it is becoming more scarce every day, while not many years ago it formed a component part of almost every landscape in the southern and eastern portions of Africa."

THE KOODOO.*

This is one of the handsomest of all the Antelopes. It is more slender in build and smaller than the Eland, which it somewhat resembles. The horns are about four feet long, and form most graceful

KOODOO.

open spirals like corkscrews, there being a ridge along their whole length. The females are horn-less. The ear is large and trumpet-shaped, moved at the slightest noise towards its source. The eyes are large and liquid. The body colour is slaty-grey, with transverse white markings, like those on the striped variety of the Eland. A small mane extends along the neck and withers, and another from the chin to the throat and breast. The tail is of moderate length, and hairy. This species is most abundant in Southern Africa, but it extends as high as Abyssinia. It is able to travel with very great speed, and makes prodigious bounds. It stands about five feet in height at the shoulders.

"Majestic in its carriage," writes Captain Harris, with all the enthusiasm of a true sportsman, "and brilliant in its colour, this species may with propriety be styled the king of the tribe. Other Antelopes are stately, elegant, or curious, but the solitude-seeking Koodoo is absolutely regal! The ground colour is a lively French grey approaching to blue, with several transverse white bands passing over the back and loins: a copious mane, and deeply fringed, tricoloured dewlap, setting off a pair of

* *Strepsiceros kudu.*

ponderous yet symmetrical horns, spirally twisted, and exceeding three feet in length. These are thrown along the back as the stately wearer dashes through the mazes of the forest or clambers the mountain-side. The old bulls are invariably found apart from the females, which herd together in small troops, and are destitute of horns."

ANGAS' HARNESSED ANTELOPE.*

This elegant animal, much like the Koodoo in its proportions, stands three feet four inches high at the shoulders. In the male, which alone bears horns, these appendages are nearly two feet long, twisted and sub-lyrate, having sharply-pointed tips of a pale straw colour, their other parts being of a brownish-black, deeply ridged for half their length from their bases. The colour of the body is greyish-black, tinged with purplish-brown and ochre, white transverse stripes, like those of the Koodoo, being present on the neck, flanks, and cheeks. A black mane courses down the neck, whilst from the neck and belly depends long shaggy hair in abundance, reaching to the knees. The ears are large, and the face is of a bright sienna-brown. The tail is one foot eight inches long, black above, with under side and tip white. The female is small, and of a bright rufous colour, with transverse stripes more numerous than in the male.

This species is found in troops of eight or ten together, feeding on the mimosa bushes in the Zulu country. Closely allied to it is a second from Central Africa, which is of a dull bay, nearly uniform, colour, the horns reaching thirty inches in length. It is known as Speke's Antelope.

THE HARNESSED ANTELOPES.†

The Harnessed Antelopes proper are all of small size, the elegant Guib not being larger than a Goat, its proportions being infinitely more delicate. It is of a pale bay colour, and the distinct transverse white streaks, running down from the middle of its back with connecting bands, have given the origin to its name.

The Bush Buck differs in wanting any body stripes. It is also African. Writing of it, Mr. Drummond remarks that the Bush Buck, "the male of whom is known as the 'Ukouka,' and the female as the 'Umbabala,' and which differ so greatly that experience is necessary to teach one that they are of the same species, is undoubtedly the finest in every way of all the Antelopes, whether found in the [Cape] Colonies or interior, that are known to the hunter as 'small game.' In size it resembles a full-grown Fallow Buck, weighing, according to age and condition, from nine to thirteen stone; its colour is a dark reddish-brown, often verging into black, and with indistinct markings on the sides, haunches, and legs; it has a great deal of hair, and a considerable mane, while the neck, which is thick out of all proportion, is nearly bare. The last mentioned peculiarity detracts from the otherwise graceful outlines of its body, the more so, perhaps, from the head being so finely shaped and small. The horns are nearly straight, rough, and ringed for about three inches from their base, and then taper away, smooth and polished, to an almost invisible point; they vary from nine inches to a foot long, and from the way in which they are set on the skull, the immense strength in the neck and shoulders of the animal, and their extreme sharpness, form about as formidable weapons as could well be imagined, especially as their owner is the most plucky Antelope, without exception or consideration of size, with which I have become acquainted in Africa. I do not think that in all my experience . . . I remember a single instance in which a Ukouka has not tried to charge when wounded and brought to bay; and no one, even after a very moderate experience, would ever allow any Dog on which he placed any value to attack them."

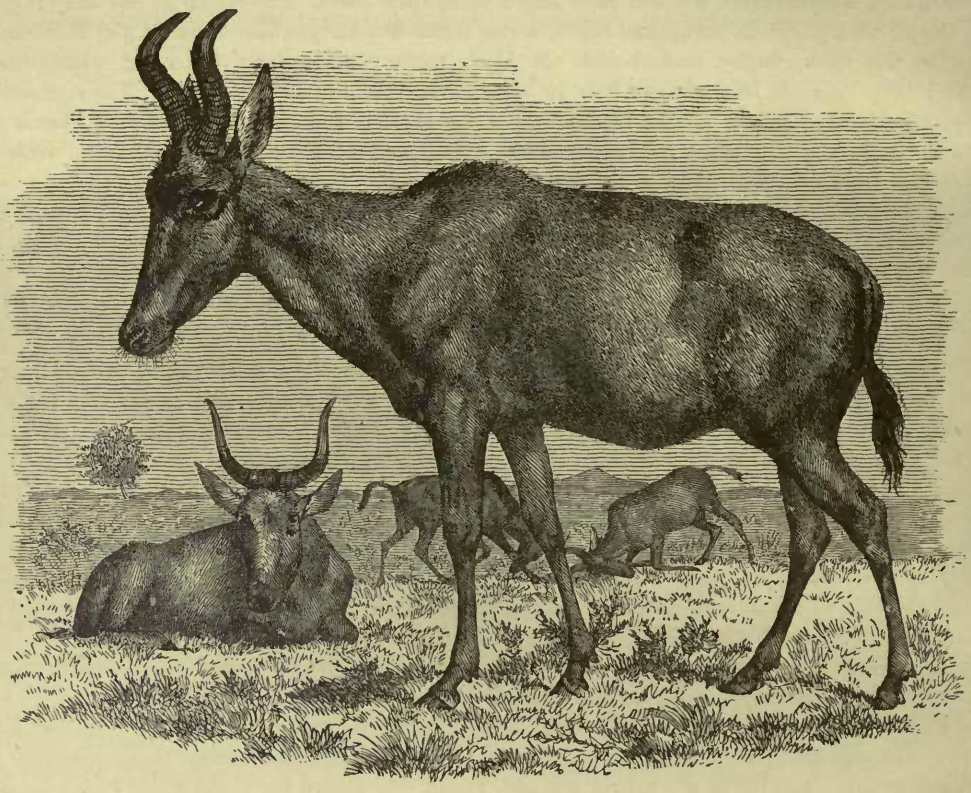
THE BOVINE ANTELOPES.‡

The Bubaline Antelope, together with the Hartebeest, has a peculiarly elongated and narrow head, at the same time that the body is not elegant in its proportions, being triangular in form, heavy in the shoulders, and falling away behind. The horns, which are smaller in the females, are turned abruptly backwards at their tips after having been directed forwards and upwards in a lyrate manner. The Bubaline of North Africa is of a uniform bay colour, and the much more recently discovered

* *Euryceros Angasii.* † The genus *Tragelaphus.* ‡ The *Damalidæ.*

Tora Antelope of Eastern Africa resembles it in this respect, whilst its horns differ slightly in their direction and size, being more divergent and slender. The Hartebeest is grey-brown, and black on the outer sides of the limbs, with large, triangular white spots on the haunches; a black line also runs down the middle of the face from between the horns.

Mr. Pringle, when writing on the Hartebeest, says of it that it "is one of the largest and handsomest of the Antelope family. . . . In the nooks of the narrow ravines, through which the game are wont to descend from the steep and stony mountains, for change of pasturage, or to drink at the fountains that ooze from their declivities, I have frequently found fresh skulls and horns of the Hartebeest, those slight relics being all that remained to indicate that there the Lion had surprised



BUBALINE ANTELOPE.

and rent his prey, and that the ferocious Hyæna had followed and feasted on the fragments, devouring even the bones, except the skull and a few other unmanageable portions."

The Blesbok, Bonte-bok, and Sassaby are about the size of a calf three months old. Their horns are lyrate and ringed at their bases. The two former are of a purple-red colour, white faces and white rumps. Of the Blesbok, Mr. C. J. Andersson remarks—"It is of a beautiful violet colour, and is found in company with black wilde-beests and Spring-boks in countless thousands, on the vast green plains of short, crisp, sour grass occupying a central position in South Africa. Cattle and Horses refuse to pasture on the grassy products of these plains, which afford sustenance to myriads of this Antelope, whose skin emits a most delicious and powerful perfume of flowers and sweet-smelling herbs."

The Sassaby, or Bastard Hartebeest of the Cape colonists, stands four feet and a half in height. It has strong horns a foot in length, crescentic, with the points directed inwards. Its body colour is a dark purple-brown above, which changes into dusky-yellow underneath, a slate-coloured patch extending from the shoulder and the hip down to the knee and hock, at the same time that the rump is fawn-coloured. The tail is nearly two feet long.

THE GNUS.*

The GNU and the BRINDLED GNU are two of the most grotesque of creatures. With the head not unlike that of a small Cape Buffalo, it has the limbs and hind-quarters not unlike those of a pony, in proportions as well as size. The nose is broad and flattened, with a bristly muzzle. The horns are broad at the base, where they nearly meet, and after turning downward as well as forward, they again turn up abruptly in a hook-like manner. They are found abundantly in Southern Africa, where, as their flesh is worthless, they are not much hunted. They are extremely wild and fearless, and remarkably tenacious of life. Their speed is great, and they have a habit of prancing about and kicking out furiously when suspecting danger. Both species have a mane along the neck, and lengthy hair between the forelegs. In both the tail is long, covered with a mass of hair not unlike that of the Horse.

The Common Gnu is of a deep brown-black, the tail and mane being white, whilst the bushy beard, running back to the chest and between the forelegs, is black. Lengthy black hairs, diverging

GNU.

and ascending from a median line, cover the upper part of the nose, at the same time that other smaller tufts under the eyes help to give a most ferocious aspect to the face. From Captain Harris's description of the animals of South Africa, an excellent idea of the peculiarities of the creature may be gained. "Of all quadrupeds," he writes, "the Gnoo is probably the most awkward and grotesque. Nature doubtless formed him in one of her freaks, and it is scarcely possible to contemplate his ungainly figure without laughter. Wheeling and prancing in every direction, his shaggy and bearded head arched between his slender and muscular legs, and his long white tail streaming in the wind, this ever-wary animal has at once a ferocious and ludicrous appearance. Suddenly stopping, showing an imposing front, and tossing his head in mock defiance, his wild red sinister eyes flash fire, and his snort, resembling the roar of a Lion, is repeated with energy and effect. Then lashing his sides with his floating tail, he plunges, bounds, kicks up his heels with a fantastic flourish, and in a moment is off at speed, making the dust fly behind him as he sweeps across the plain."

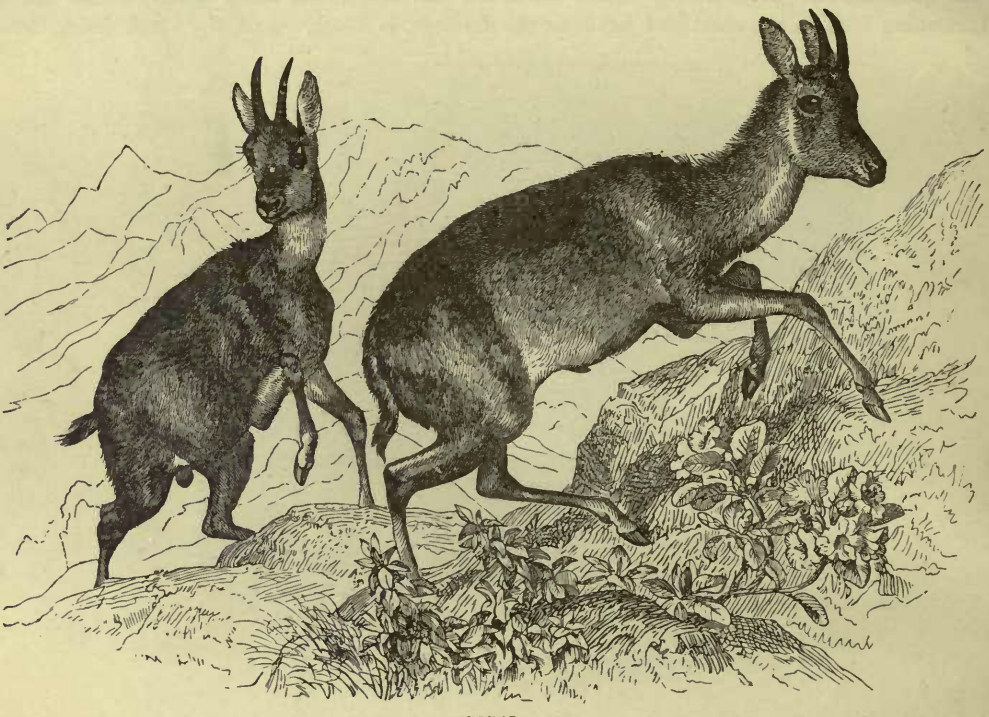
In the Brindled Gnu the front of the face lacks the lengthy hair of its ally; the tail is also black instead of white. Its body colour is a dirty dun, variegated with obscure pale streaks. This species, as well as the Common Gnu, is the constant companion of the equally abundant Quaggas of the same region.

* The genus *Catoblepas.*

THE CAPRINE ANTELOPES.

The Serow (sometimes written Surrow) of India, the Cambing-outan of Sumatra, with the Goral of North India, form a small group of strongly-built Goat-like Antelopes, with short, conical, upright horns, ringed at the base, and of nearly equal size in both sexes. The feet are large, and the tapering tail short.

Captain Kinloch gives us the following account of the Serow. He says it "is an ungainly-looking animal, combining the characteristics of the Cow, the Donkey, the Pig, and the Goat! It is a large and powerful beast. . . . The body is covered with very coarse hair, which assumes the form of a bristly mane on the neck and shoulders, and gives the beast a ferocious appearance, which does not belie its disposition. The colour is a dull black on the back, bright red on the sides, and white underneath, the legs also being dirty white. The ears are very large; the muzzle is coarse. . . . The



GORAL.

Serow has an awkward gait; but in spite of this can go over the worst ground; and it has, perhaps, no superior in going down steep hills. It is a solitary animal, and is nowhere numerous; two or three may be found on one hill, four or five on another, and so on. It delights in the steepest and most rocky hillsides, and its favourite resting-places are in caves, under the shelter of overhanging rocks, or at the foot of shady trees."

Of the Goral, the same author remarks that it "is an active little beast, and much resembles a small Goat, but the back is more arched. The prevailing colour is a brownish-grey, with a dark stripe along the back, and dark markings on the legs. Underneath the throat is a large white spot, which is very conspicuous when the animal is standing above one, and often betrays its presence when it would otherwise have escaped observation. The hair is soft but rather coarse, and about two inches long." In the male the horns reach nine inches in length.

The Cambing-outan stands about two feet and a quarter at the shoulder. Its long, coarse hair is brown-black in colour, the mane and throat alone being white. The horns are not more than six inches in length, cylindrical, slightly annulated and curved backwards at their lips. Mountain forests, where it leads a particularly active life, are its haunts.

Dr. J. Anderson remarks of the TAKIN, or BUDORCAS, another allied species, "Major Stewart informs me that it is found in all the high ranges of the north-east of Debrooghur, and is far from uncommon. The Mishnees, with their very inferior appliances to shoot and catch them, are, nevertheless, frequently dressed in their skins, or have a part of a skin with the hair on as an ornament, which would seem to indicate that they are numerous. . . . They are seen in pairs, and sometimes in herds of twenty or more. They are swift of foot and good climbers."

In Formosa and Japan there are also Goat-like Antelopes, that from the former locality being named after Mr. Swinhoe, who discovered it. Its horns are short and conical, its brown fur harsh and crisp. Both closely resemble the Cambing-outan. There is still another with a long tail inhabiting Northern China.

The MAZAMA, or Mountain Goat of California and the Rocky Mountains, is an allied species, with short, thick, conical, recurved horns, and long, straight, soft hair of a white colour, specially abundant in the region of the throat, shoulders, sides, and tail. Its size is that of a large Sheep, which it much resembles in physiognomy. The flesh has an unpleasant musky flavour, the skin is thick and spongy, at the same time that the hair is considered of but little value.

HEAD OF THE CHAMOIS.

THE CHAMOIS.*

This well-known Goat-like Antelope inhabits the snow-clad mountains of Europe, from the Pyrenees to the Caucasus, ascending during the summer, and in winter going below the line of snow in search of food. Both sexes possess horns—black, short, and cylindrical—rising perpendicularly and parallel from the forehead for some distance, then forming a small hook directed backwards to their pointed tips. These rarely exceed seven inches in length. The female is slightly smaller than the male, which stands a little over two feet at the shoulder. In winter the colour of the lengthy, hairy coat is dark brown, which becomes a brownish-yellow in the summer, a darker streak along the back alone remaining. The head is pale yellow, darker from the nose upwards to between the ears and around the eyes. Behind the horns and between the ears is a pair of peculiar glands, opening externally, the function of which is unknown. The voice of the species is a rough bleat under all ordinary circumstances; but when the one which watches whilst the others feed—and there is always found to be one such in every herd—finds cause to fear, it gives a shrill whistle as a danger signal to its companions.

The senses of sight, hearing, and smell of the Chamois are developed to a maximum, and this fact, taken in association with the animal's great sure-footedness among the lofty, snow-covered Alps, in which it has its home, makes hunting it a task of no mean difficulty and danger. Dogs are of no service on the rocky eminences to which the Chamois will retreat when it is pursued, and the sportsman has to rely upon his own surefootedness and courage in climbing the steep and slippery precipices, whither he is tempted by the sight of game. If so hard pressed that it is driven to some height beyond which it cannot go, it is said that it will precipitate itself upon its pursuer, sending him down into the depths below. Besides man, the eagle is an enemy whose constant endeavour is to obtain the kids from their watchful mothers. Its skin is much valued for its toughness combined with its pliability. Its flesh is also greatly esteemed.

* *Rupicapra tragus.*

THE ORYXES.*

Of the Antelopes there is a fairly well-marked section, distinguished by the possession of horns in both sexes, at the same time that the body is peculiarly deep at the shoulder, whilst the lengthy tail is cylindrical and tufted at the extremity. Among these there is a mane along the neck in three closely-allied species, the BLAUBOK, or Equine Antelope of South Africa, the SABLE ANTELOPE of the Transvaal and the eastern coast of Africa, and BAKER'S ANTELOPE, or the Maarif of Upper Nubia, as well as in the ORYX, which is found in many parts of Africa, the BEISA of Abyssinia, the BEATRIX ANTELOPE of Arabia, and the GEMSBOK of South Africa; whilst in the not distant ADDAX ANTELOPE of North Africa there is no nape-mane, but a slight one on the throat.

ORYX.

In the Blaubok, which stands more than four feet and a half at the shoulder, with a glaucous-grey coat upon a black skin; in the Sable Antelope, which stands four feet and a half, being black except upon the abdomen, as well as in streaks upon the face, which are white; and in Baker's Antelope, which stands four feet eight inches, being of a pale fulvous liver colour, the horns are two feet and more in length, and curved gently backwards, being ringed transversely except at the tips, where they are smooth. In the Oryx, the Beisa, the Beatrix Antelope, and the Gemsbok, the lengthy conical horns, although similarly ringed, are much more slender, starting backwards in a line with the face, whilst in those previously mentioned they rise at an angle from it, being straight in the Gemsbok and Beisa, very slightly curved backwards in the Beatrix, and more so in the Oryx. In the nearly allied Addax the similarly-constructed horns are gently twisted in a corkscrew manner. All these last-mentioned Antelopes are pale in colour, being almost white, with the throat protected by long black hair.

Whilst speaking of the Beisa Antelope, Mr. Blanford remarks that "the appearance of a herd of Oryx is very imposing. They are some of the most elegant and symmetrical of animals, the motions

* The genus *Oryx*.

being those of a Wild Horse rather than of an Antelope. Their favourite pace appears to be either a steady quick walk or a trot; they rarely break into a gallop unless greatly alarmed. When frightened they dash off, sometimes snorting and putting their heads down, as if charging, raising their long tails, and looking very formidable. They are wary animals, though far less so than some other Antelopes. It is said that they frequently attack when wounded, and their long, straight horns are most deadly weapons."

Of the Gemsbok, Captain Harris tells us that it "is about the size of an Ass, and nearly of the same ground colour, with a black list stripe down the back and on each flank, white legs variegated with black bands, and a white face, marked with the figure of a black nose-band and head-stall, imparting altogether to the animal the appearance of being clad in half-mourning. Its copious black tail literally sweeps the ground; a mane reversed, and a tuft of flowing black hair on the breast, with a pair of straight, slender horns (common to both sexes) three feet in length, and ringed at the base, completing the portrait." The resemblance between the Gemsbok, when seen from the side view, and the Unicorn of heraldry, is sufficiently striking to make it more than probable that the conception of the latter originated in the former.

The author just quoted says of the Blaubok, or Roan Antelope, by which name it is also known, that it "is an inhabitant of the elevated downs and ridges about the source of the river Limpopo [four degrees to the west of Delagoa Bay, and a little north of it], and being utterly destitute of speed, may be ridden to a standstill without difficulty. . . . It is heavily built, and has an upright mane, long asinine ears, and robust scimitar-shaped horns."

CHAPTER III.

ARTIODACTYLA: RUMINANTIA—BOVIDÆ (*Concluded*).—OXEN, PRONGHORN ANTELOPE, MUSK [DEER], AND GIRAFFE.

THE NYL-GHAU—Description—Habits—THE MUSK OX—Difficulties in associating it—Distribution—Habits—THE OX—Chillingham Wild Cattle—Their Habits—Domestic Cattle—The Collings, Booth, and Bates Strains—American Breeding—Shorthorns, and other Breeds—Hungarian Oxen—Zebu—Gour—Gayal—Curious mode of Capturing Gayals—Banting—THE BISONS—Description—European Bison, or Aurochs—Almost extinct—Cæsar's description of it—American Bison—Distribution—Mythical Notions regarding it—Their Ferocity and Stupidity—"Buffalo" Flesh—THE YAK—Habits—THE BUFFALOES—Varieties—Description—Fight between two Bulls—THE ANOA—THE PRONGHORN ANTELOPE—Peculiarity as to its Horns and Skull—Professor Baird's and Mr. Bartlett's Independent Discovery of the Annual Shedding of the Horns—Habits—Peculiarity about its Feet—Colour—Difficulties as to its Position—THE MUSK [DEER]—Its Perfume—Where is it to be placed?—Description—Habits—Hunters for the Perfume—Their Sufferings—THE GIRAFFE—Peculiarities—Skull processes—Its Neck—Habitat—Running power—Habits—Hunting.

THE NYL-GHAU, OR BLUE OX.*

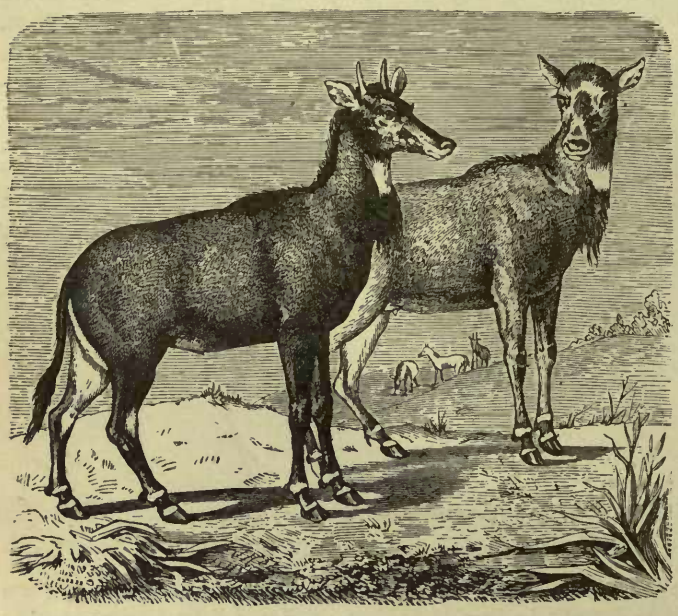
THIS is the largest of the Antelopine animals found in India, the adult male standing over four feet in height at the shoulders, which are at a considerably higher level than the haunches. The female is about one-third smaller than her consort, and without horns, which in the male are but short, rarely exceeding nine inches in length, and rising perpendicularly from the head. Each horn is black, smooth, angular, and turned slightly forward, ending in a sharp point.

The body colour of the male is a slate blue, darker about the head and under parts of the body, whilst the legs are black; the female is tawny-red; the aged bull is nearly black. A short mane runs along the neck and over the highest part of the shoulder, in which latter situation it is of greater length. There is a considerable tuft of dark hair hanging from the middle of the front of the neck, over six inches in length, which is situated just below a conspicuous white, anchor-shaped throat-patch, the shank of which runs up between the two halves of the lower jaw almost to the lip. On each cheek also there is a circular white spot below and behind the eye. A transverse

* *Portax picta.*

white line above and below each fetlock stands out conspicuously also. The inner sides of the thighs are white, this colour extending for some distance upwards and inwards. There is a white patch also in front of each pastern joint. The tail is lengthy, and tufted at the end. The ears are nearly of the same length as the horns. The limbs are elegantly shaped, though rather heavy, and their proportions show a tendency towards those of the Giraffe, which animal it also resembles in the employment of its tongue for seizing food, and not its lips.

The Nyl-Ghau is found only in continental India, where it abounds in parts, not being a favourite with sportsmen, because its small horns are so insignificant a trophy, but more so with the larger members of the Cat tribe—the Tiger and the Leopard—as well as the wild Dog, with whom it is a frequent meal. Its temper is uncertain, which fact, when taken in connection with its powerful build, makes it a dangerous pet. It lives well in confinement. When attacking, it drops on its knees, and thus advances until it feels itself within a sufficient distance of its foe to make a sudden leap upon it, which it can do with great velocity and force. The leather manufactured from its skin is valuable, but its flesh is never eaten by the Hindoos, on account of their belief that it belongs to the Ox tribe, which it is not lawful to slay. With a good Horse in open country, the Blue bull may be hunted successfully with spears. It is very tenacious of life. The first specimens introduced into England were brought from Bombay by Lord Clive in 1767.

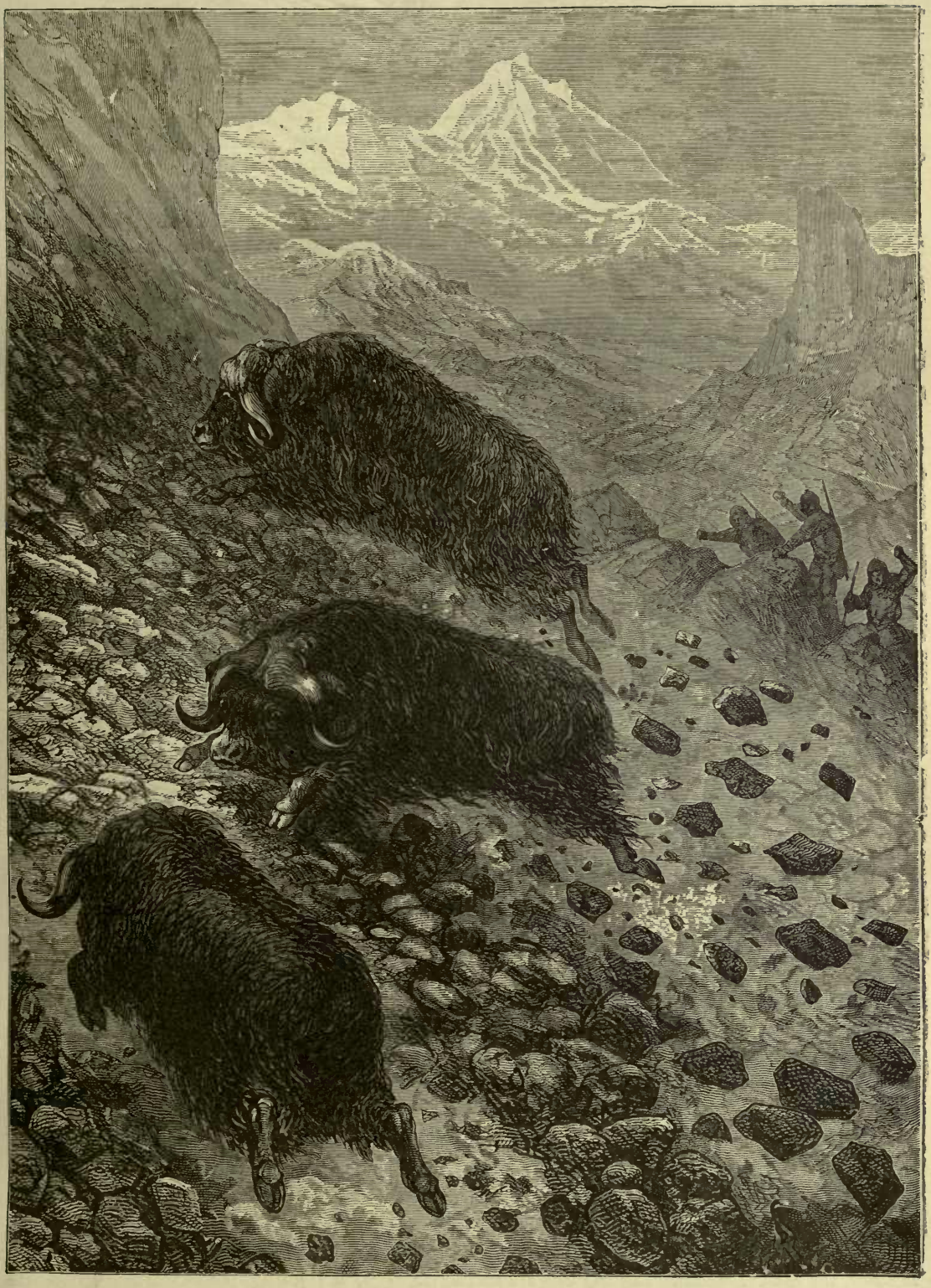


NYL-GHAU.

THE MUSK OX*

is an animal whose exact affinities it is not easy to determine. By some naturalists it has been thought to be intermediate between the Sheep and the Ox, whence its scientific generic name, *Ovibos*. It is found only in Arctic America north of latitude 60°, and exhales a strong musky odour at certain seasons of the year, an approach to which is recognisable in several of the Bovidæ. It is a heavy-built, but not large creature, with short legs, and a very lengthy brown hairy coat, which almost reaches to the ground. Its horns are very similar in form to those of the Cape Buffalo, and in the bulls they meet in the middle line of the forehead. The tail is very short, being entirely hidden by the fur of the haunches. The nose is not naked, as in the Oxen, but is almost entirely covered with hair, as in the Elk and Reindeer, both Arctic ruminants also. The spread of their feet is considerable, and they can cover the ground at no little speed. Captain Franklin describes their habits as follows:—"The Musk Oxen, like the Buffalo, herd together in bands, and generally frequent barren grounds during the summer months, keeping near the rivers, but retire to the woods in winter. They seem to be less watchful than most other wild animals, and when grazing are not difficult to approach, provided the hunters go against the wind. When two or three men get so near a herd as to fire at them from different points, these animals, instead of separating or running away, huddle closer together, and several are generally killed; but if the wound is not mortal they become enraged, and dart in the most furious manner at the hunters, who must be very dexterous to evade them. They can defend themselves with their powerful horns against Wolves and Bears, which, as the Indians say, they not unfrequently kill. The Musk Oxen feed on the same substances as the

* *Ovibos moschatus.*

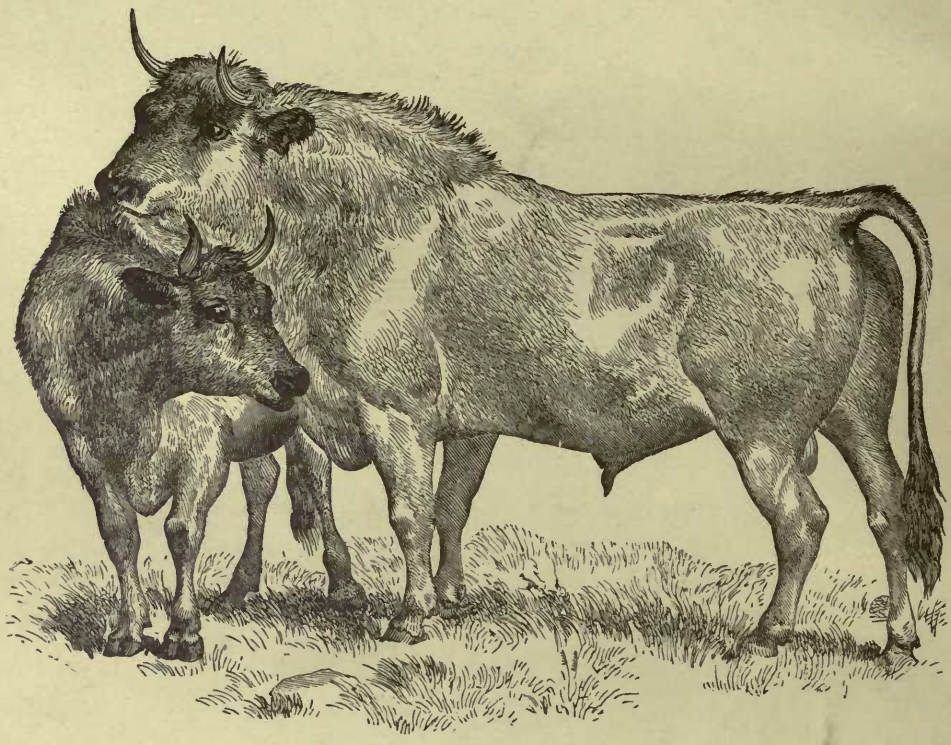


MUSK OXEN.

Reindeer; and the prints of the feet of these two animals are so much alike, that it requires the eye of an experienced hunter to distinguish them. The largest killed by us did not exceed in weight three hundred pounds."

THE OX.*

It being quite unnecessary to describe the general form and proportions of this animal, as seen among us in a domesticated state—Shorthorns, Alderney, Highland, &c.—we will at once proceed to notice the famous cattle of Chillingham Park, in Northumberland, which are known to have been in existence in the thirteenth century. The wild cattle there are all cream white, with a brown muzzle, with the insides and tips of the ears reddish-brown, at the same time that the horns are white tipped with black, of which latter colour are the hoofs. Calves more or less coloured are



CHILLINGHAM CATTLE.

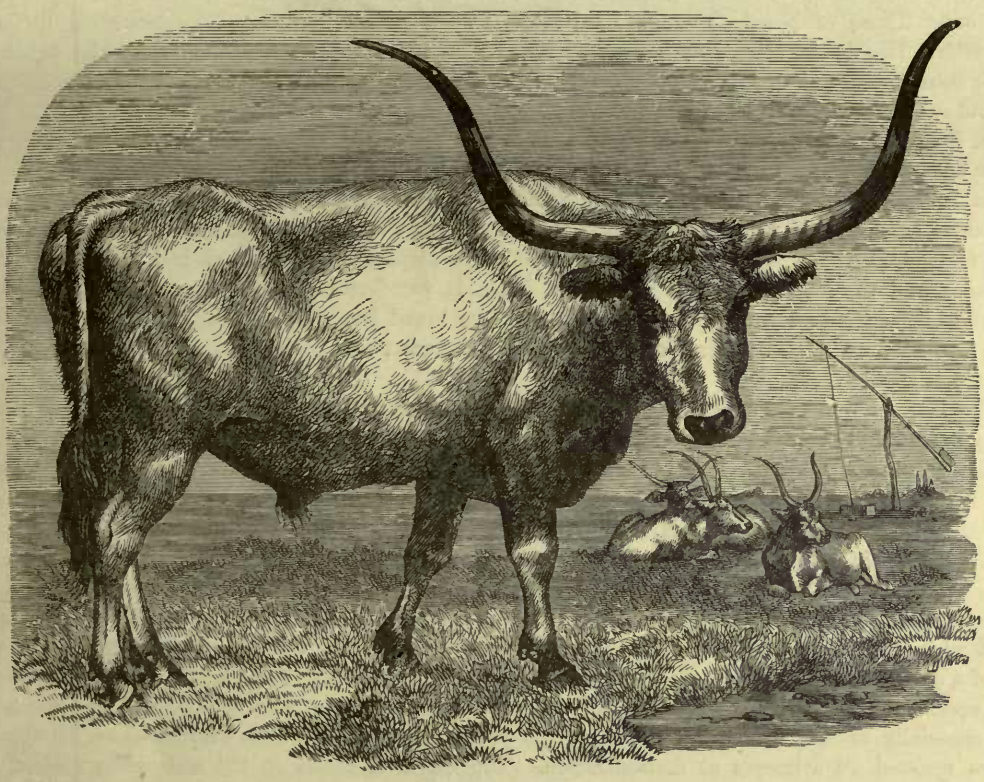
occasionally born, but these are promptly destroyed by the keepers. Some of the bulls have a thin, short mane. Their habit, on strangers approaching them, is to "set off in a full gallop, and at a distance of about two hundred yards make a wheel round and come boldly up again, tossing their heads in a menacing manner. On a sudden they make a full stop at the distance of forty or fifty yards, looking wildly at the object of their surprise; but upon the least motion being made, they all again turn round and fly off with equal speed, but not to the same distance, forming a shorter circle; and again returning with a bolder and more threatening aspect than before, they approach much nearer, probably within thirty yards, when they again make another stand, and then fly off. This they do several times, shortening their distance, and advancing nearer and nearer, till they come within such a short distance that most people think it proper to leave them, not choosing to provoke them further." They differ from domestic cattle in that they feed at night, and generally sleep during the day. They also hide their calves.

In all the so-called wild cattle of Great Britain the forehead is flat or slightly concave, the head is small, the back is straight, and the legs are short.

* *Bos taurus.*

It is now almost universally agreed that domestic cattle are descended from two or three species of the genus Bos, which existed in late geologic or prehistoric times, the remains being found in Switzerland, Ireland, and other parts of Europe. The Zebu, Yak, Gayal, and Arni, to be referred to immediately, have also been domesticated.

Cattle have been so distributed and mixed in breeding that any precise arrangement of the breeds according to their ancestral affinities can scarcely be tabulated. Most important of the heavy breeds are the well-known Shorthorns of the north of England, so carefully and successfully developed by Charles and Robert Colling between 1780 and 1818, at Ketton and Barmpton, close to Darlington, in Durham, by a process of in-and-in breeding—"Hubback," *the* "Duchess," "Lady Maynard,"



HUNGARIAN BULL.

"Young Strawberry," "Foljambe," and "Comet," the last bull of which, at Charles Colling's sale in 1810, fetched a thousand guineas.

Following close upon the Collings came the Booths—Richard, Thomas, and J. Booth—between 1814 and 1864, at Studley, Killerby, and Warlaby, where "Isabella," the twin sisters "Necklace" and "Bracelet," were parents of goodly herds, "Commander-in-Chief" being one of the latest gems. On one occasion, it is stated, Mr. Richard Booth, of Warlaby, refused the unique offer of fifteen hundred guineas for a cow named "Queen of the May."

In 1810 Thomas Bates, of Ridley Hall, and afterwards of Kirkleavington, then a well-known breeder of cattle, purchased at Charles Colling's sale "Young Duchess," daughter of "Comet," a granddaughter of "Duchess" by "Daisy" bull, and she became the founder of the famous "Duchess" tribe. In 1831, with the accession of the bull "Belvidere," a descendant of Robert Colling's "Princess" tribe, the "Duchess" breed produced "Short Tail" and the renowned "Duke of Northumberland." The "Matchem" cow, purchased at the same date, did much to improve the stock. Mr. Bates died in 1849.

Several enterprising American breeders have, since 1817, introduced Shorthorns into the United

States and Canada, Colonel Lewis Sanders, of Kentucky, being the first who did so on anything like thorough principles. Others followed his example with success, especially about the year 1852, when a fresh impulse was given to their production because of the rise of price in meat, as well as the foreign demand for it. The Booth and Bates bloods predominate in these animals, and form the basis of much of the beef now re-shipped to England.

The great advantage of the Shorthorn breed is that they, together with a good temper, combine the advantages of great size and aptitude to fatten, rapidly reaching maturity. For dairy purposes they are excelled by the Suffolk Duns and Ayrshire cattle, the latter, with their enormous udders, broad hips, and deep flanks, being the best as milkers. Hereford, North Devon, and Scottish black Shorthorns are inferior to those of the northern counties in their slowness of growth and power of filling out. Those of North Devon are particularly symmetrical in form. The mountain cattle of the western Highlands, otherwise known as the Kyloe breed, are best known from the hardiness of their constitutions, protected as they are by their thick hides and shaggy coats. The Welsh and Shetland cattle resemble them in many respects.

In Hungary, Turkey, and Western Asia there is a breed of large cattle with peculiarly long and slender outward-spreading horns, black-tipped, and greyish throughout the rest of their length.

In India, the Sacred Cattle, or ZEBUS, with convex forehead, short horns, large drooping ears, and a short head, possess a high hump upon the withers, as well as an ample dewlap falling in undulating folds along the whole length of the neck. Their disposition is mild, as is indicated by their expression, and the liberty they are allowed in India is wonderful. They vary greatly in size, some being not bigger than an average month-old calf. The breed has extended in times gone by through Persia into Eastern Africa, where it is found with a narrower and flatter face, at the same time that the hump is smaller.

The introduction of steam, as well as the extension in the employment of the Horse, has almost entirely superseded the use of cattle as beasts of burden or draught in highly civilised nations.

The GOUR, the GAYAL, and the BANTING are three species of wild cattle found in the Oriental world from India to Java, peculiar in possessing a ridge running along the middle of the back, and horns which, after running outwards from the head, are directed upwards and not backwards. Of these the Gour of Central India is the largest, measuring six feet at the withers, having also a convex profile, very high withers, and an arched back, which makes the line from the nose to the root of the tail, along the spine, a fairly continuous curve. Its colour is a deep brown glossy black, excepting a ring of white encircling the base of each hoof, and a white tuft on the forehead. There is not any trace of a dewlap in either sex. The horns are not more than two feet in length, strong, and curved boldly upwards at their tips. The Gour is found abundantly in herds of twenty or so around the table-lands, especially of South Bahar, feeding on the young leaves of the trees and shrubs. It appears to have resisted all attempts at domestication. The Gayal is found in the hill-region east of the Brahmaputra. It is much the size of English cattle. The bull is bold, and the cow easily domesticated. Its home is the deep jungle, where it can obtain the young leaves and shoots of the brushwood. According to Mr. Macrae the following is the method employed by the Kookies of the Chittagong hill-region to catch the animal :—"On discovering a herd of wild Gayals in the jungle, they prepare a number of balls, of the size of a man's head, composed of a particular kind of earth, salt, and cotton. They then drive their tame Gayals towards the wild ones, when the two herds soon meet and assimilate into one; the males of the one attaching themselves to the females of the other, and *vice versâ*. The Kookies now scatter their balls over such parts of the jungle as they think the herd most likely to pass, and watch its motions. The Gayals, on meeting these balls as they pass along, are attracted by their appearance and smell, and begin to lick them with their tongues; and relishing the taste of the salt, and the particular earth composing them, they never quit the place until all the balls are consumed. The Kookies, having observed the Gayals to have once tasted their balls, prepare a sufficient supply of them to answer the intended purpose, and as the Gayals lick them up they throw down more; and it is to prevent their being so readily destroyed that the cotton is mixed with the earth and the salt. This process generally goes on for three changes of the moon, or for a month and a half, during which time the tame and the wild Gayals are always together, licking the decoy balls, and the Kookie, after the first day or two of their being so, makes his appearance at such a distance as not to alarm the wild

ones. By degrees he approaches nearer and nearer, until at length the sight of him has become so familiar that he can advance to stroke his tame Gayals on the back and neck without frightening the wild ones. He next extends his hand to them, and caresses them also, at the same time giving them plenty of his decoy balls to lick. Thus, in the short space of time mentioned, he is able to drive them, along with the tame ones, to his parrah, or village, without the least exertion of force; and so attached do the Gayals become to the parrah, that when the Kookies migrate from one place to another, they always find it necessary to set fire to the huts they are about to abandon, lest the Gayals should return to them from the new grounds."

The Gayal carries its nose forwards, as a rule, like a Buffalo. Its ears are longer than those of the Ox. It possesses a dewlap smaller than in the Zebu. The tail is short, not descending below the hock. Its general colour is a varying and generally dark brown, the abdomen and the legs being white in parts. Its cry is a shrill, insignificant lowing. Its horns are conical, turned directly outwards, and a little upwards at their tips, not exceeding one foot and a half in length.

The Banting extends from Cochin China, through the Indo-Malay archipelago, to the islands of Bali and Lombok. Its colour and proportions are almost exactly those of the Gour.

THE BISONS.*

Closely related to the Oxen are the Bisons of Europe and of North America, together with the Tibetan Yak. The two species of Bison agree closely with one another in general appearance, the American form being shorter and weaker in the hind-quarters, and a little smaller altogether.

The hair of the head and neck is very abundant and long, forming a mane of very dark colour, at the same time that it nearly conceals the eyes and ears as well as the base of the short conical horns, which are directed outwards and upwards. Under the chin there is a lengthy beard. A line of lengthy hair also extends along the back nearly to the tail, which is itself only covered with short soft hair, except at the end where there is a lengthy tuft. There is a hump developed on the shoulders, at which spot the adult male is nearly six feet in height, the female being smaller.

The European Bison, or Aurochs, is on the verge of extinction, surviving only in the forests of Lithuania, Moldavia, Wallachia, and the Caucasus, on account of the severe laws against its destruction. The horns are longer and more curved than in the American species. The females are less hairy and smaller than their mates. Its strength is very great, and an old bull is said to be a match for at least four Wolves. Its speed is considerable, and it raises its hoofs above the level of its lowered head whilst galloping.

In his description of the Black Forest (*Sylva Hercynia*) Cæsar describes the species (the Urus) thus:—"They are but little less than Elephants in size, and are of the appearance, colour, and form of a Bull. Their strength as well as their speed is very great. They spare neither man nor beast that they see. They cannot be brought to endure the sight of men, nor can they be tamed, even when taken young. The people, who take them in pitfalls, assiduously destroy them; and young men harden themselves in this labour, and exercise themselves in this kind of chase; and those who have killed a great number, the horns being publicly exhibited in evidence of the fact, obtain great honour. The horns, in magnitude, shape, and quality, differ much from the horns of our Oxen. They are much sought for, and after having been edged with silver at their open ends, are used for drinking vessels at great feasts."

According to some authorities, however, it is a mistake to identify the European Bison with the Aurochs.

To all intents and purposes the American Bison is an extinct animal, killed off by the rifle and the rail and the encroachment of man upon its haunts. A few specimens are preserved with what may be described as laudably jealous care in the Yellowstone Park, and small herds may be found in Montana, Texas, and Canada.

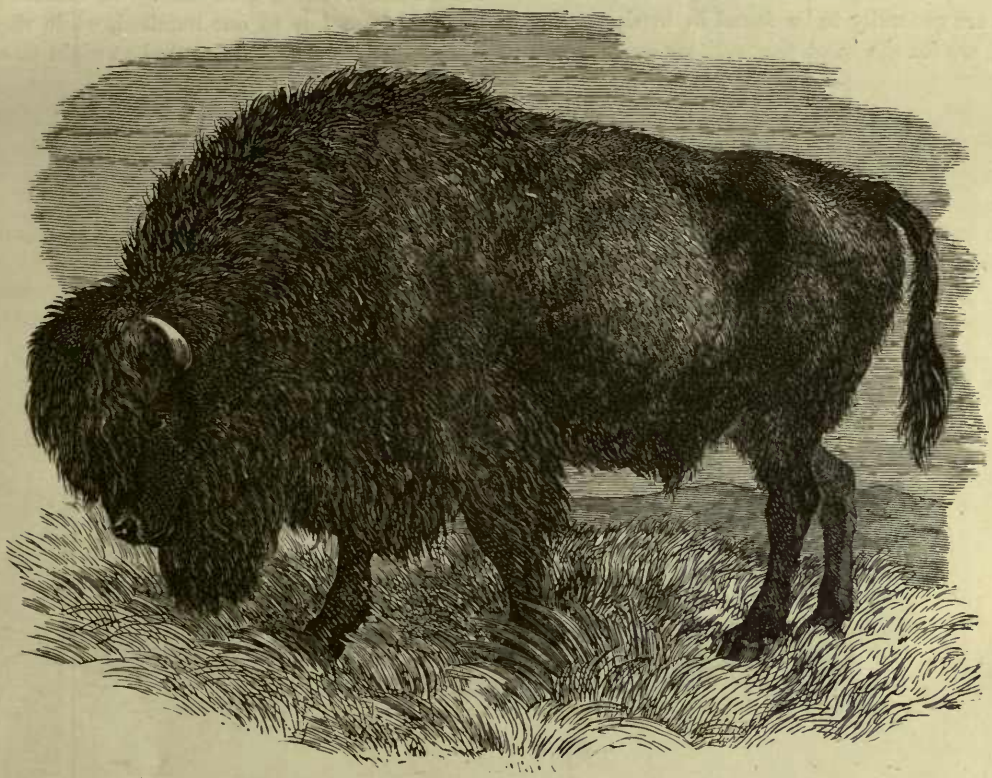
Huge herds, numbering millions of individuals, "so numerous as to blacken the plains as far as they can reach," were once a common sight on the prairies, and repeatedly stopped the Kansas Pacific Railway when first formed. Hunters spread false notions as to the organisation of these herds,

* The genus *Bison*.

EUROPEAN BISON.

which was of a most simple character, excellently explained by Mr. Allen, who says that the timidity and watchfulness of the cows, accustomed as they were to the care of their offspring, led them to take the initiative in the movements of the herd, and this kept them near the front, especially when the herd was moving. The popular belief that the bulls kept the cows and the young in the middle of the herd, and formed themselves, as it were, into a protecting phalanx, had some apparent basis; but the theory that the old bulls, the least watchful of all the members of the herd, were sentinels posted on the outskirts to give notice of an approaching enemy, was wholly a myth, as was also the supposition that the herd consisted of small harems.

These "Buffaloes," as they were generally called, were much like domestic cattle in their habits.



AMERICAN BISON.

They were, however, fond of wallowing in the mud, and so coating themselves with a protection from their insect pests. Their ferocity of appearance was not evident in their true natures, for their disposition was sluggish and fearful. Colonel Dodge remarked of them that, "endowed with the smallest possible amount of instinct, the little he has seems adapted rather for getting him into difficulties than out of them. If not alarmed at sight or smell of a foe, he will stand stupidly gazing at his companions in their death-throes, until the whole herd is shot down. He will walk unconsciously into a quicksand or quagmire already choked with struggling dying victims. Having made up his mind to go a certain way it is almost impossible to swerve him from his purpose."

The flesh of the "Buffalo" was thought equal to the best beef if from the young animal, but dry and insipid when from the adult. The tongue and hump were esteemed great delicacies. Pemmican was made mostly from the dried flesh, pounded fine and mixed with an equal weight of tallow.

The YAK differs from the Bisons mostly in the distribution of its long hair, which, instead of being situated on its hump and neck, forms a lengthy fringe along the shoulders, flanks, and thighs, and completely invests the tail, which latter is much prized in India, where it is known as "Chowry," and is employed as a fly-switch in great ceremonials.

The Yak is a native of the high ground of Tibet, where it is rigorously protected by the native government against the foreign sportsman. Its colour is black, except some spots upon the face, which are white or grey. Its tail is often white, as is frequently the long hair tuft on the top of the withers. Its horns reach nearly a yard in length, and are directed outwards, forwards, and then upwards. Its voice is much like that of a Pig, whence the name Grunting Ox, by which it sometimes goes.

As to the habits of the creature, Captain Kinloch tells us that "the Yak inhabits the wildest and most desolate mountains; it delights in extreme cold; and is found, as a rule, at a greater elevation than any other animal. Although so large a beast, it thrives upon the coarsest pasturage, and its usual food consists of a rough, wiry grass, which grows in all the higher valleys of Tibet, up to an elevation of nearly 20,000 feet. . . . Yak seem to wander about a good deal. In summer, the cows are generally to be found in herds varying in number from ten to one hundred, while the old bulls are for the most part solitary or in small parties of three or four. They feed at night or early

YAK.

in the morning, and usually betake themselves to some steep and barren hillside during the day, lying sometimes for hours in the same spot."

THE BUFFALOES.*

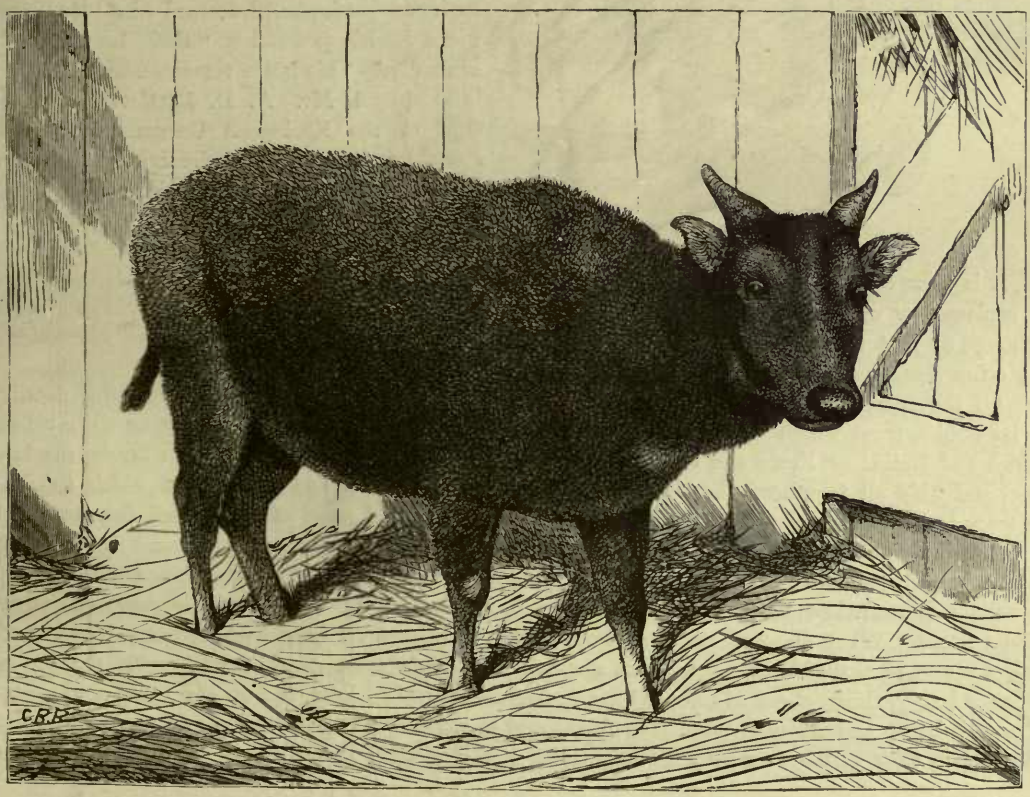
The Buffaloes have the horns flattened and triangular in section, inclined outwards and backwards, turning up at the tips. The Common Buffalo is found in Southern Europe, North Africa, and the Indian region. The huge Indian variety, with most lengthy horns, is also known as the Arni. Its horns are elongated and narrow, sometimes reaching six feet and a half in length. It stands nearly or quite six feet at the shoulder, its proportions are bulky, and its general colour dusky-black. It lives in small herds numbering not more than twenty, and solitary bulls are often met with which attack sportsmen in a most vicious manner without provocation. The Cape Buffalo has shorter horns, expanded at their bases, so that they almost meet in the middle line of the forehead. It is found all over Central and South Africa, and is a formidable animal when wounded, as, quite regardless of the cloud of smoke which follows the shot aimed at it, it charges right through it, and so does

* The genus *Bubalus*.

frequent injury to the experienced hunter. Its general colour is blue-black, but in some cases it has a reddish tinge. The Hon. W. H. Drummond gives the following account of a fight between two bulls of which he was an eye-witness. After having had his attention attracted by a loud clattering noise, he remarks that, "on looking through the edge of the last thicket which had concealed them, I saw two Buffalo bulls standing facing each other with lowered heads, and, as I sat down to watch, they rushed together with all their force, producing the loud crash I had before heard. Once the horns were interlocked they kept them so, their straining quarters telling that each was doing his best to force the other backwards. Several long white marks on their necks showed where they had received scratches, and blood dripping over the withers of the one next me proved that he had received a more severe wound. It was a magnificent sight to see the enormous animals, every muscle at its fullest tension, striving for the mastery. Soon one, a very large and old bull, began to yield a little, going backwards step by step; but at last, as if determined to conquer or die, it dropped on to its knees. The other, disengaging its horns for a second, so as to give an impetus, again rushed at him, but, whether purposely or not I could not tell, it did not strike him on the forehead, but on the neck, under the hump, and I could see that with a twist of his horns he inflicted a severe wound. However, instead of following up his seeming advantage, he at once recoiled, and stood half facing his antagonist, who, getting on his legs again, remained in the same position for several minutes, and then with a low grunt of rage, rushed at him. This time he was not met, and his broad forehead struck full on his rival's shoulder, almost knocking it over. The old bull then went a few yards off and stood watching the other for fully a quarter of an hour, when he walked slowly away in the opposite direction."

The Cape Buffalo, which is found all over Africa south of the equator, is replaced in the north-eastern portion of the continent by a smaller variety, of a browner colour, and with much shorter horns, which are not closely approximated at their bases, at the same time that they spread out almost horizontally instead of curving downwards and backwards.

In western and the western-equatorial parts of Africa there is again another still smaller variety,



ANOA.

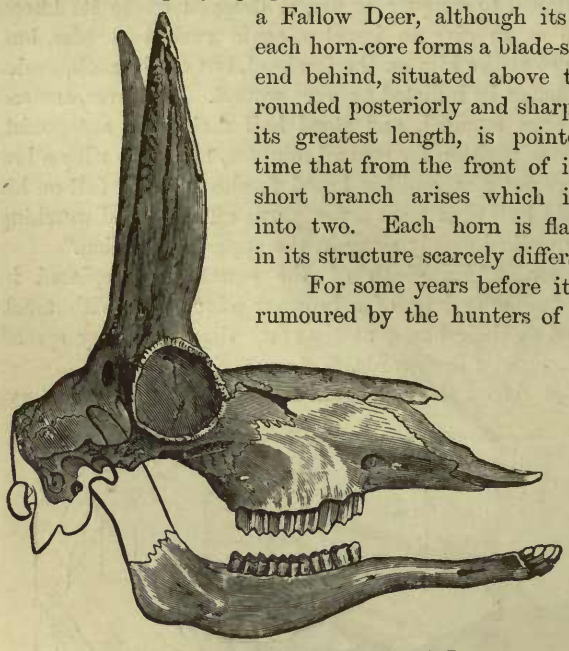
in which the hair is yellowish-red instead of nearly black or brown, the short horns being, as well, directed considerably upwards instead of directly outwards.

In the Island of Celebes the smallest species of Buffalo is found, which differs but little in appearance from the young of the Cape species. It is known as the ANOA; is black, with short, wavy hair, and has short, parallel prismatic horns directed upwards from the forehead.

THE PRONGHORN ANTELOPE.*

This Antelope of North America, one of the few forms of the Hollow-horned Ruminants which inhabit the New World, is different from all the other members of the group in two respects at least, namely, that its horns are branched, as implied in the name, and that they are annually shed.

The accompanying figure is a side view of the skull of the animal, whose size is nearly that of a Fallow Deer, although its build is not so heavy. It is there seen that each horn-core forms a blade-shaped projection six inches long, with the pointed end behind, situated above the eyes perpendicular to the line of the face, rounded posteriorly and sharpened in front. Each horn itself is a foot or so in its greatest length, is pointed and gently curved backwards, at the same time that from the front of it, very slightly above the middle of its height, a short branch arises which is directed forwards, the whole there dividing into two. Each horn is flattened from side to side, is not annulated, and in its structure scarcely differs from that of a Sheep or Goat.



SKULL OF THE PRONGHORN ANTELOPE.

For some years before it was certainly known to be the case, it had been rumoured by the hunters of Fort Union that the Pronghorn Antelope shed its horns each year; and in the year 1858 Dr. C. A. Canfield, of Monterey, California, in writing to Professor Baird, of the Smithsonian Institution, Washington, informed him that in specimens in his possession "their horns drop off annually." This letter remained unprinted until in England Mr. A. D. Bartlett, Superintendent of the Zoological Gardens in Regent's Park, London, in 1865 drew attention to the same fact, which was observed by him in a male animal living in the Gardens at the time.

The horns—not antlers, be it noticed—are, it is now certain, detached each year from their supporting cores, and subsequently dropped, to be replaced by others which at the time of shedding have already advanced some way in growth, although at first they are very pale and soft. In this respect the Pronghorn is not resembled by any other Antelope, and differs entirely from the Deer.

Of the species Dr. Canfield, in the letter above referred to, gives several interesting details as to its habits, from which we may infer that they are not so cunning or so fleet as their allies in Africa and India:—"From the 1st of September to the 1st of March they run in bands, the bucks, does, and kids all together," shortly after which time the young are born, upon which the bucks separate and wander about alone until the following season. "A band of Pronghorn Antelopes, when frightened, never run directly away from you, but cross over in front of you, running across your path from one side to the other repeatedly, and keeping about a hundred yards ahead. On this account it is sometimes easy, on a smart Horse, to run into a drove of them and catch one of them with a noose. When one is alone, and is watched by a person or animal and becomes frightened, it makes a sort of shrill blowing noise like a whistle, and then commences bounding off. On the neck it has a heavy, thick, chestnut-coloured mane, five or six inches long, and on the rump a white patch of coarse hair; and when the animal is frightened it always erects the mane and the hair and this white spot, thus giving it a very singular and characteristic appearance as it runs bounding away

* *Antilocapra americana.*

PRONGHORN ANTELOPE.

from you. The Antelope has a very peculiar odour, strong and, to some people, offensive. . . On the whole, I consider the meat of the Pronghorn to be very excellent."

There is a peculiarity in the feet of the Pronghorn in which it resembles the Giraffe, a few Antelopes, and the different members of the Camel tribe, namely, that the false hoofs, as well as their supporting bones, are entirely absent, from which it may be inferred, as is the case, that the number of digits in each foot is only two.

In the females of the species the horns are present, but they are much reduced in size, and almost hidden in the hairy covering of the head. The end of the nose—in other words, the muffle—is hairy, and not, therefore, damp at all times in any part, as is that of the Ox and most ruminants. The tail is very short; the fur is very short and close set, being stiff and wavy. Its colour is a pale fawn above and on the limbs, whilst the breast as well as the abdomen are a yellowish-white, at the same time that the tail and round about it are pure white, as is the inside of the ear.

Although the Pronghorn is here described after all the more ordinary hollow-horned Ruminantia, it is far from impossible that it is much more intimately related to some one of the above-mentioned families than to the others. It must either have originated direct from the earliest type of Bovine Ruminant, and from that time continued isolated until the present day, or it may have been a straggler from some already differentiated group, like the Gazelles, for instance, that, arriving in a land so unlike the haunts of its progenitors, took on itself from altered circumstances peculiar modifications in its horn-growth and foot-form which have resulted in its present characteristics.

THE MUSK [DEER].*

This interesting animal, from the male of which is obtained a powder contained in a pouch about the size of an orange, on the surface of the abdomen, and which is one of the most fragrant of perfumes, is generally included among the Cervidæ. Nevertheless, there are many reasons in favour of its being considered an Antelopine animal. Apart from the fact that it has a gall-bladder, which is not found in any Deer, but in almost all Antelopes, its pale grey hair is peculiarly coarse and Goat-like, and the absence of antlers or horns in both sexes tells in neither direction, for, as in the Brockets of South America and the Chinese Muntjac, the antlers are rudimentary, so are the horns in the Bush-bucks of Africa, and in some domestic Sheep as well as Oxen.

SKULL OF THE MUSK [DEER].

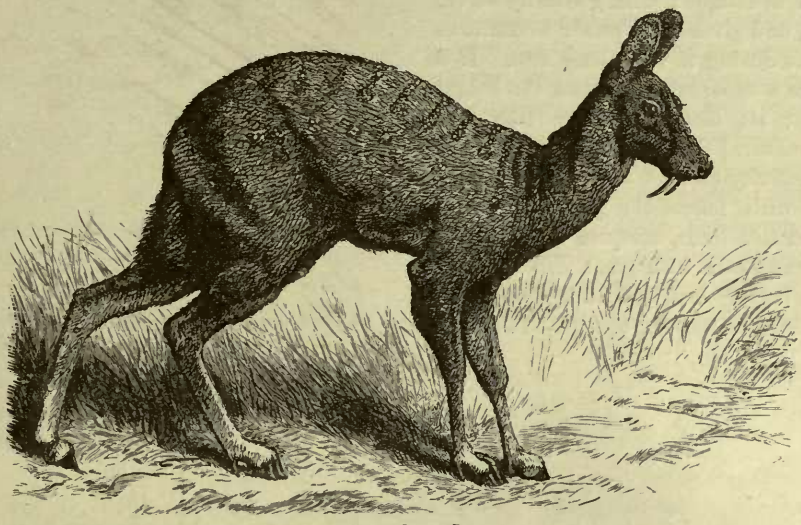
The presence of enormous canine tusks, three inches long, would at first sight seem to be in favour of its relations with the Deer, because in the Muntjacs they are also found. Nevertheless there is no *à priori* reason why these formidable weapons should not be developed in a hollow-horned ruminant; for, cropping up independently in genera so distant as the Deerlets, the Muntjacs, and the Water Deer, why should they not do so in the Antelopes as well?

The Musk is twenty inches in height, its ears large, and its tail rudimentary. Its hoofs are small, but their spread is large, because of the yielding attachment of the false hoofs, as in the Reindeer. The coarse and brittle hair is grey and slightly brindled. Its habitat is Central Asia, from the Himalaya Mountains to Pekin, at elevations above 8,000 feet.

"The Musk Deer," according to Captain Kinloch, "is a solitary and retiring animal; it is nearly nocturnal in its habits, remaining concealed in some thick bush during the daytime, and only coming out to feed in the mornings and evenings. It frequents the highest parts of the forest, preferring the birch, rhododendron, and juniper, and is almost always found alone, rarely in pairs, and never in flocks. No animal seems more indifferent to cold, from which it is well protected by its thick coat of hollow hair, which forms as it were a sort of cushion, which acts as an insulator, and enables the Deer to lie even on snow without much loss of animal heat. It is amazingly active and sure-footed, bounding along without hesitation over the steepest and most dangerous ground. Its usual food seems to be leaves and flowers, but the natives say that it will kill and eat Snakes."

* *Moschus moschiferus.*

The value of the Musk perfume causes the animal to be persecuted beyond measure. From Chardin we learn that the hunters are obliged to cover the nose and mouth with linen when removing the scent-sac, to prevent pulmonary hæmorrhage. "I have," says he, "gained accurate information respecting this circumstance, and as I have heard the same thing talked of by some Armenians who had been to Boutan, I think that it is true. The odour is so powerful in the East Indies



MUSK [DEER].

that I could never support it, and when I trafficked for musk I always kept in the open air, with a handkerchief over my face, and at a distance from those who handled the sacs; and hence I know by experience that this musk is very apt to give headaches, and is altogether insupportable when quite recent. I add that no drug is so easily adulterated, or more apt to be so."

THE GIRAFFE.*

Apart from its unique proportions and its size, the Giraffe presents peculiarities in its organisation which compel us to separate it from the Deer on the one hand, and the hollow-horned ruminants on the other. In both these groups the appendages on the head, whether developed as antlers or as horns, are distinct prolongations from the forehead bones themselves. In the Giraffe, however, the three bony appendages, one median and two lateral, all covered with skin, instead of being produced as outgrowths from any portion of the skull, are separate and independent conical bony "processes" which stand upon the skull, capping roughened conical prominences destined to support them. Neither are horns, like those of Sheep or Oxen, nor antlers like those of the Deer, ever found upon these processes, a tuft of hair alone surmounting the lateral pair.

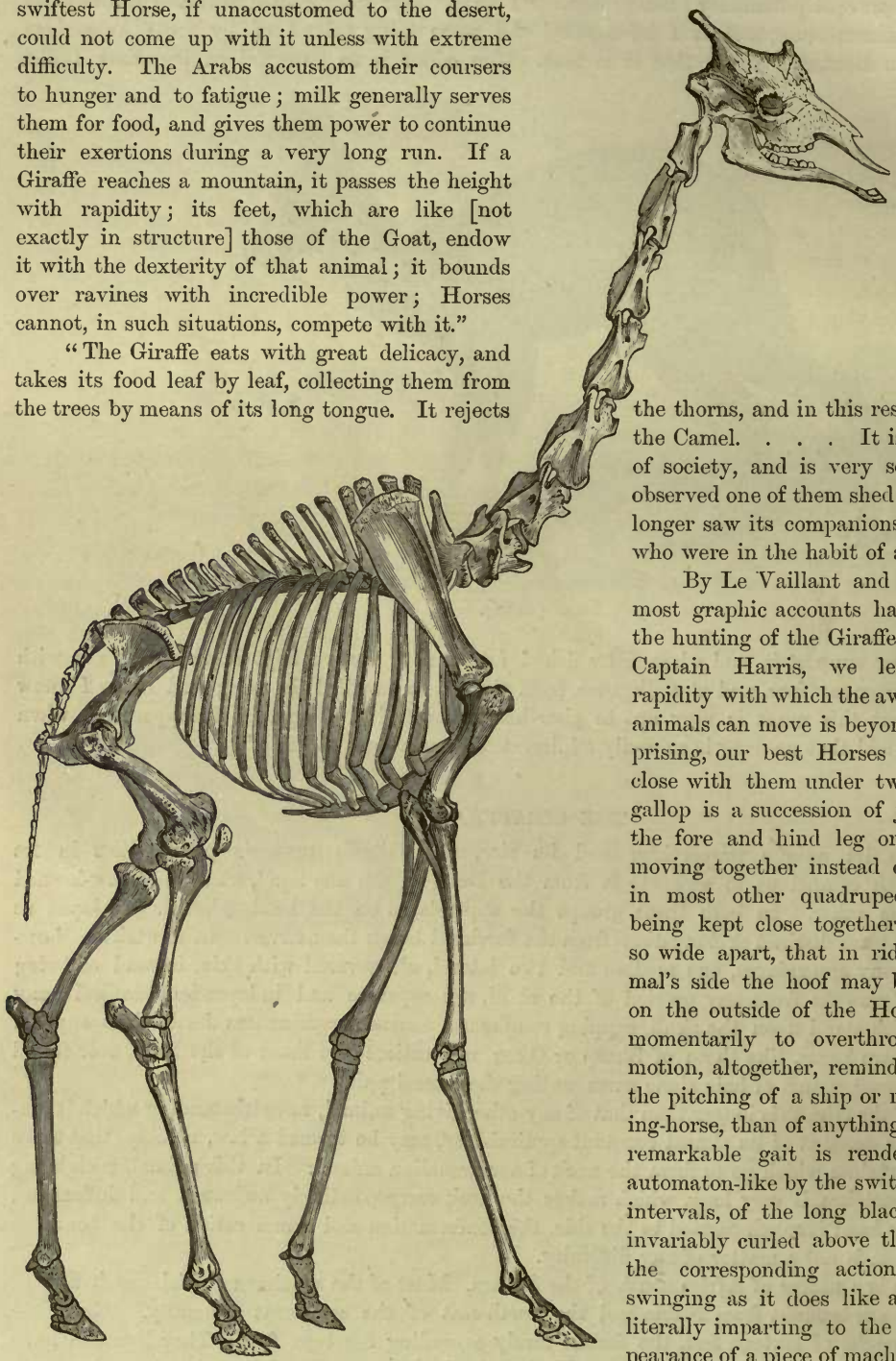
The neck of the Giraffe is longer than that of any other living animal, notwithstanding which it conforms to what, on account of its almost constant applicability, may be termed a law, namely, that there are but seven vertebræ which go to form the neck of a mammalian animal. In this animal, such being the case, each vertebra is very long, which makes the neck correspondingly awkward and inflexible; so that when the head is much carried to the side, the conformation and enumeration of the bones in the cervical region is not a matter of any difficulty.

The Giraffe is a native of Africa south of the Sahara. Most of the specimens which reach Europe in a living state are brought from Nubia and the north-east of the continent generally. The adult male attains a height of sixteen feet, the female rarely exceeding fourteen feet. They live and have bred well in captivity, although, as may be readily imagined, they are most delicate, and require much special care, particularly to prevent the joints of their lengthy limbs from being injured.

* *Camelopardalis giraffa.*

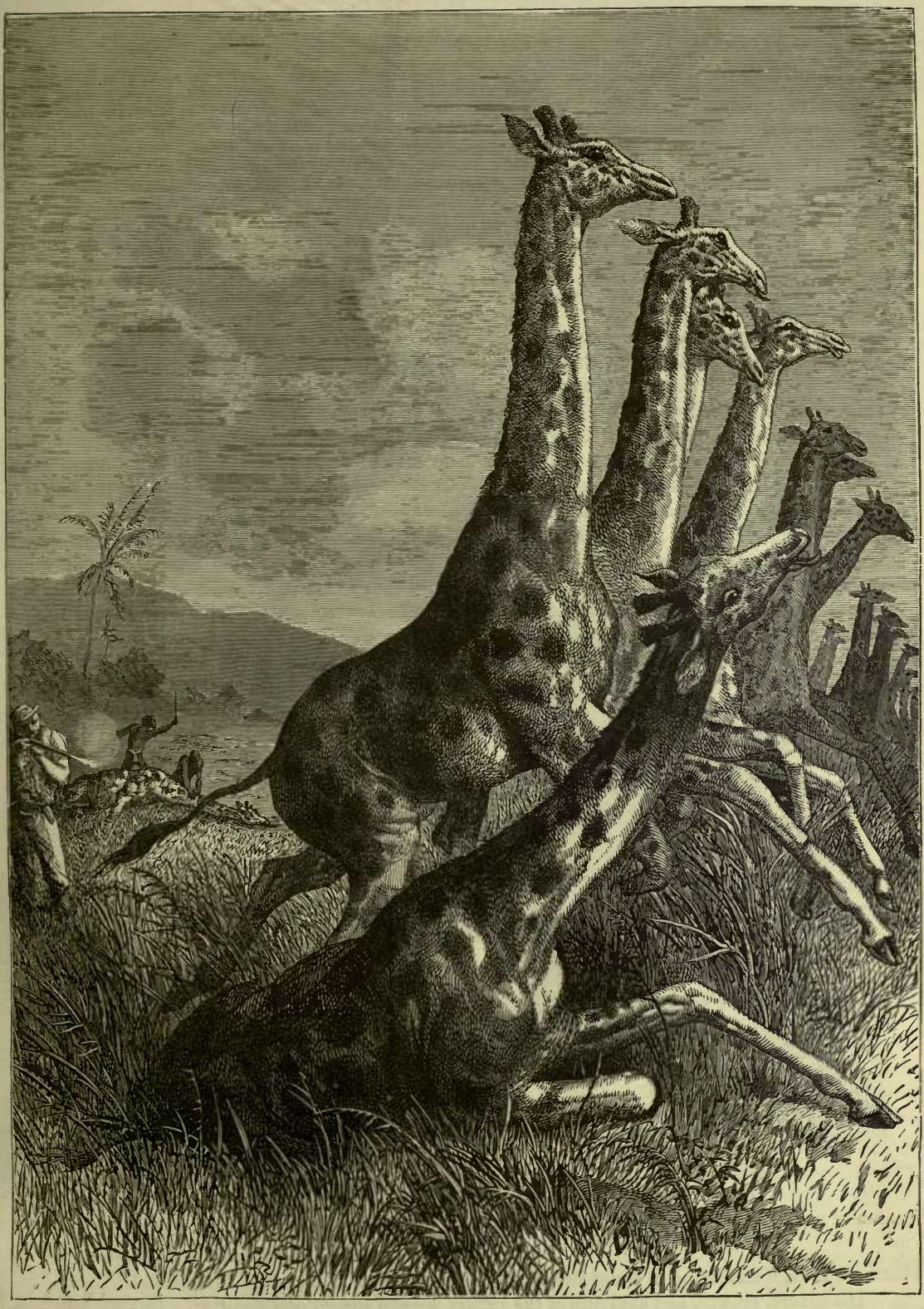
M. Thibaut, who, in 1836, obtained the first specimen of the Giraffe alive for the Zoological Gardens in Regent's Park, tells us that "the first run of the Giraffe is exceedingly rapid. The swiftest Horse, if unaccustomed to the desert, could not come up with it unless with extreme difficulty. The Arabs accustom their coursers to hunger and to fatigue; milk generally serves them for food, and gives them power to continue their exertions during a very long run. If a Giraffe reaches a mountain, it passes the height with rapidity; its feet, which are like [not exactly in structure] those of the Goat, endow it with the dexterity of that animal; it bounds over ravines with incredible power; Horses cannot, in such situations, compete with it."

"The Giraffe eats with great delicacy, and takes its food leaf by leaf, collecting them from the trees by means of its long tongue. It rejects the thorns, and in this respect differs from the Camel. . . . It is extremely fond of society, and is very sensible. I have observed one of them shed tears when it no longer saw its companions or the persons who were in the habit of attending it."



SKELETON OF THE GIRAFFE.

By Le Vaillant and other sportsmen most graphic accounts have been given of the hunting of the Giraffe. Quoting from Captain Harris, we learn that "the rapidity with which the awkwardly-formed animals can move is beyond all things surprising, our best Horses being unable to close with them under two miles. Their gallop is a succession of jumping strides, the fore and hind leg on the same side moving together instead of diagonally, as in most other quadrupeds; the former being kept close together, and the latter so wide apart, that in riding by the animal's side the hoof may be seen striking on the outside of the Horse, threatening momentarily to overthrow him. Their motion, altogether, reminded me rather of the pitching of a ship or rolling of a rocking-horse, than of anything living; and the remarkable gait is rendered still more automaton-like by the switching, at regular intervals, of the long black tail, which is invariably curled above the back, and by the corresponding action of the neck, swinging as it does like a pendulum, and literally imparting to the animal the appearance of a piece of machinery in motion. Naturally gentle, timid, and peaceable, the unfortunate Giraffe has no means of protecting itself but with its heels; but even when hemmed into a corner, it seldom resorts to this mode of defence."



GIRAFFES.

CHAPTER IV.

THE CERVIDÆ, OR ANTLERED RUMINANTS: THE ELK, ELAPHINE, SUB-ELAPHINE, AND RUSINE DEER.

The Deer Tribe—Distinguishing Characters—Exceptions to the rule—The Musk (Deer) and Chinese Water Deer—Other Characters of the Cervidæ—Antlers, their Nature, Growth, and Shedding—The Knob—"Velvet"—Getting rid of the "Velvet"—Full equipment—Contests—Interlocking Antlers—Distribution—Classification—Development of Antlers in the Common RED DEER—Explanation of the various stages—Splendid "Heads"—Simple and Complex Antlers—Types of Antlers—THE ELK, OR MOOSE DEER—Appearance—Antlers—Habits—Hunting—THE ELAPHINE DEER—THE RED DEER—Distribution—Appearance—Hunting—THE WAPITI—Acting of the Fawns—THE PERSIAN DEER, OR MARÂL—THE CASHMERIAN DEER, OR BARASINGHA—Habits and General Appearance—BARBARY DEER—SUB-ELAPHINE DEER—THE JAPANESE, FORMOSAN, AND MANTCHURIAN DEER—THE FALLOW DEER—Peculiarity of its Antlers—THE PERSIAN FALLOW DEER—THE RUSINE DEER—THE SAMBUR, OR GEROW—Habits—Species of Java, Formosa, Sumatra, Borneo, Timor, Ternate, and the Philippines—THE HOG DEER—THE AXIS DEER—PRINCE ALFRED'S DEER—THE SWAMP DEER—SCHOMBURGK'S DEER—ELD'S DEER, OR THE THAMYN—Description—Habits—Hunting—Shameful havoc.

THE Deer tribe, known scientifically as that of the CERVIDÆ, is more circumscribed, and therefore better defined, than are the BOVIDÆ, or hollow-horned ruminants. Their best distinguishing character is that in the males there is each year developed a pair of antlers which is shed at the end of the season to be reproduced in the following spring. The females do not carry antlers, except in the case of the Reindeer, in which, although these elegant appendages are of the same form as in their mates, they are constructed upon a much smaller scale. There are, however, one or two Deer in which not even the males carry antlers, and these are the only members of the family with reference to which there is any serious doubt on the subject of affinity. The Musk (*Moschus moschiferus*) may be taken as an example. In this pretty creature, which is more fully described on pages 42—3, there are no antlers and no horns. Nevertheless, other peculiarities in its organisation have led most naturalists to include it among the Cervidæ, a position which is, however, so doubtful that it is quite possible that it may be an aberrant member of the bovine section, as we have for several reasons thought best to consider it.

A more certain Deer without antlers is the Water Deer of China, the flesh of which has formed an article of food among the natives of Shanghai for years. This small Deer has lengthy tusks, as has the Musk Deer, and nearly every member of the family in which the antlers are diminutive. Its very existence was not known in Great Britain until the year 1862, when Mr. Swinhoe, then our consul at Shanghai, described it, which shows how ignorant we still may be of the creatures which inhabit the mighty Celestial Empire.

HEAD OF RED DEER, IN WHICH THE GROWING ANTLERS ARE SEEN COVERED WITH "VELVET."

In most other respects the Deer closely resemble the hollow-horned ruminants. Their complicated stomach does not differ from that of the Ox, and their other organs are constructed upon the same plan, except the liver, which, like that of the Giraffe, lacks a gall-bladder, this reservoir being present in nearly all the Bovidæ. Their general proportions are also much the same. The Red Deer and the Fallow Deer are those best known to most of us, as both are to be found living in Great Britain, as is the Roebuck in the north of Scotland.

The nature, growth, and shedding of the antlers deserve special consideration. In the commencement of the spring a pair of knobs is to be seen upon the forehead of the adult male animal. This is

covered with a nearly smooth dark skin; and a scar can be detected in the middle of each, which is that left by the antler of the year before, where it fell off.

As the weather becomes more propitious these knobs commence to grow, feel warm to the touch, and are evidently filled with actively-circulating blood, supplied by special vessels which are developed at the time. They do not increase regularly in all directions, for if they did the antler would be a sphere, but they sprout out, as it may be termed, around the above-mentioned scar; in most cases there being one branch which takes a direction forward, whilst a second larger one makes its way backward. These become, in the fully-formed antler, the brow antler and the main beam; and it is by other branches growing upon the beam, according to definite laws, different in different species, that the elaborate complications of the fully-developed structure are produced.

As long as the antler, which is composed of genuine bone of very dense texture, is increasing in size, it will be found to be covered with the same warm black skin as is the knob from which it sprang; and as this skin is covered with short, fine, close-set hair, it has received the name of the "velvet." It is this "velvet" which secretes the bony texture of the antler from its inner surface, just in the same way that the outer covering (the periosteum) of any long bone of the body is mainly concerned in the formation of the bone itself. As, also, in the same way, if we seriously graze our shins, and scrape off this covering, the bone exposed is very apt to die, so in the Deer any mishap to the "velvet" injures the growth of the antler in the part affected. The animals, therefore, during the time they are "in velvet" are more than usually careful to protect their cranial appendages, and are inoffensive even to strangers.

HEAD OF RED DEER, IN WHICH THE ANTLER IS FULLY DEVELOPED AND THE "VELVET" HAS DISAPPEARED.

When their antler-growth has ceased their natures change. The "velvet" has performed its function and dries into a parchment-looking membrane, to get rid of which the Deer adopt a very simple method. They rub their antlers against any neighbouring trees, and force them into the soft earth until there is none left, and the bare bone, with scarcely any trace of hollow in the middle of it, is completely exposed. Now, in the glory of their full equipment, they go in search of others of their kind, having previously maintained a comparative solitude. They try their strength by butting at imaginary enemies, and choose their wives, unless prevented by others of their species mightier than themselves, with whom, if fairly matched, they enter into the most formidable contests, to win or to be driven from the herd with ignominy. During these contests the sound of their battering antlers may be heard for considerable distances, whilst now and then, by accident, they interlock themselves inextricably, and perish both, as is attested by skulls so found, and to be seen in more than one museum.

Looking upon the Deer generally, we find them inhabiting many parts of the world—Europe,

Asia, and America. In Africa none occur south of the Sahara, they being there replaced by members of the Bovine section of the order. None are found in Australia, and in America they are far less common than in Great Britain. To understand the peculiar features and the distribution of the various species, it is necessary to classify them in groups of kindred genera, most falling into sections which are distinguishable without difficulty.

In arranging the different members of the Deer-tribe for description, there are peculiarities in their outward conformation which agree with those internal differences upon which all correct notions of relationship alone can be established. In classifying animals, naturalists must always be guided by the totality of the structure of each member of each group; but, as in describing them to those who have not made the minute details of their organisation their special study it is impossible to lay stress on all the various parts which have to be included by the student in arriving at the desired result, those outward features only can be mentioned which are found to tally with their total structure, namely, their osteology, their visceral anatomy, and their muscular arrangement. As an example of the relative importance of different external structures, we may mention that the late Dr. J. E. Gray, in his Catalogue of the Ruminant Mammalia in the British Museum, gives the following arrangement of the genera, in which the length of the tail suggests one distribution of them, whilst the shape of the antlers is in favour of another, which is very different :—

1.—*Tail very short or clubbed.*		2.—*Tail elongate, with longer hair at the end.*
Red Deer and its near allies.	Antlers elaphine	Mantchurian Deer Japanese Deer. Fallow Deer.
Eld's Deer. Barasingha Deer. Schomburgk's Deer. Sambur and its near allies.	Antlers rusine	Hog Deer. Spotted Axis.
Roebuck. Chinese Elaphure.	Antlers capreoline.	

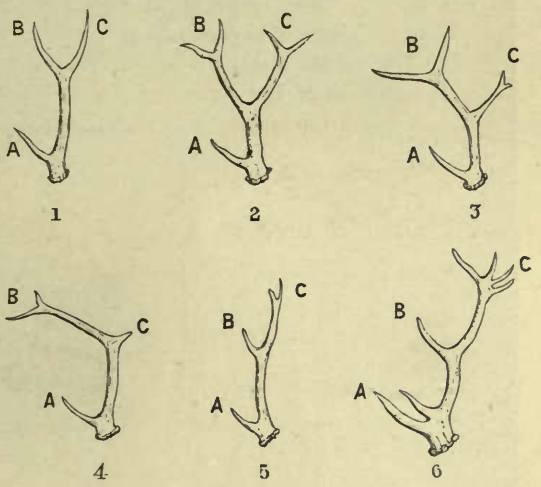
This table is useful as a means of comparing the tails of the different genera; but other points of structure do not in the least support the classification suggested by that appendage, as a result of which it has to be ignored in the consideration of distant affinities, although, where questions of specific proximity are concerned, it is found to be of considerable value.

The antlers render much more trustworthy information in the determination and expression of relationships; and their characterising features can be most readily grasped by having an ideal type in the mind wherewith to compare all aberrant and complicated specimens. This ideal type may be derived in one or other of two ways. The first of these is from the study of the antlers as they are each year developed in any given kind of Deer, commencing with its earliest age. For example, in the Common Red Deer: in the spring of the year following its birth the antlers are nothing more than straight, conical, and unbranched "beams," the animal being then known as a "Brocket." In the following spring the antler has, besides the "beam," a small branch from its base, directed forwards, known as the "brow antler;" it is then termed "Spayad." In the third year an extra front branch is formed, known as the "tres," and the whole antler is larger. This "tres" is sometimes seen in the smaller antler of the Spayad. In the fourth year the brow-antler is doubled, to form the "brow" and "bez-tyne," at the same time that the top of the main beam divides into the "sur-royals" of the "Staggard," or four-year male. In the fifth year the sur-royals become more numerous, the whole antler of the "Stag" being heavier than previously, only to be exceeded in weight by those of the fully adult "Great Hart," with ten or more "points," each being larger and longer than the year before. In Great Britain the conditions of life and the food are not of the quality which develops first-rate antlers, at the same time that it is—in Scotland, at least—the habit to shoot those with the finest heads, and so leave the indifferent specimens to perpetuate their species. In some of the ancient forests of Germany superb heads of the Red Deer are to be obtained, whilst in several of the old castles of that country antler trophies are preserved as memorials of sport in times gone by, with as many as six-and-sixty points. Lord Powerscourt has in his possession a pair with five-and-forty tynes.

The second way is from the study of the antlers of the species in which they are simple, in

comparison with those in which they are particularly complex, both methods as they ought to do, leading to the same result. There are Deer—as, for example, the American Brockets, David's Deer, and Reeves' Muntjac—in which the antler is never more than a simple dag, like that of the "Brocket" stage in the Red Deer. There are others with never more than a single tyne besides the beam, as instances of which may be mentioned the Indian Muntjac and the Huamel. Others, again—and these form an important section of the family—are triply branched, as in the Spayad, the beam bifurcating some distance above the brow-antler. As instances of these we find the Sambur Deer of India, with its large and thus simple antlers; the closely-allied Javan and Swinhoe's Deer; the Spotted Axis; the Hog Deer, and the Roebuck.

We have now arrived at the stage in which the beam has bifurcated, and almost all the more elaborate forms result from an excess in the development of both, or one or other, of the limbs of this bifurcation. In the Deer known as Elaphine—because they more or less resemble the Red Deer (*Cervus elaphus*)—the front of these two branches (the "tres") does not increase or become complicated, whilst from the much-enlarged hind one the numerous sur-royals spring in the biggest species, such as the Wapiti, Cashmere, Red, and Barbary Deer, as well as the Marāl, of Persia. In the smaller species which follow this type of structure the sur-royals are less developed, at the same time that the brow-antler does not split in two to form a "bez" as well, examples of which are to be seen in the Mantchurian, Formosan, and Japanese Deer, as well as in the Fallow Deer and its newly-discovered ally from Mesopotamia. These two last-named differ also in the "palmation" of their antlers—a peculiarity referred to further in the special description of the species.



VARIOUS TYPES OF ANTLERS.
(From the *Proceedings of the Zoological Society.*)

The accompanying outline diagram represents the most important types of antlers, to one or other of which those of almost every known Deer can be referred. To facilitate future description, they may be named as follows:—

Fig. 1.—Rusine type.
2.—Normal Rucervine type.
3.—Intermediate Rucervine type.
4.—Extreme Rucervine type.
5.—Sub-elaphine type.
6.—Elaphine type.

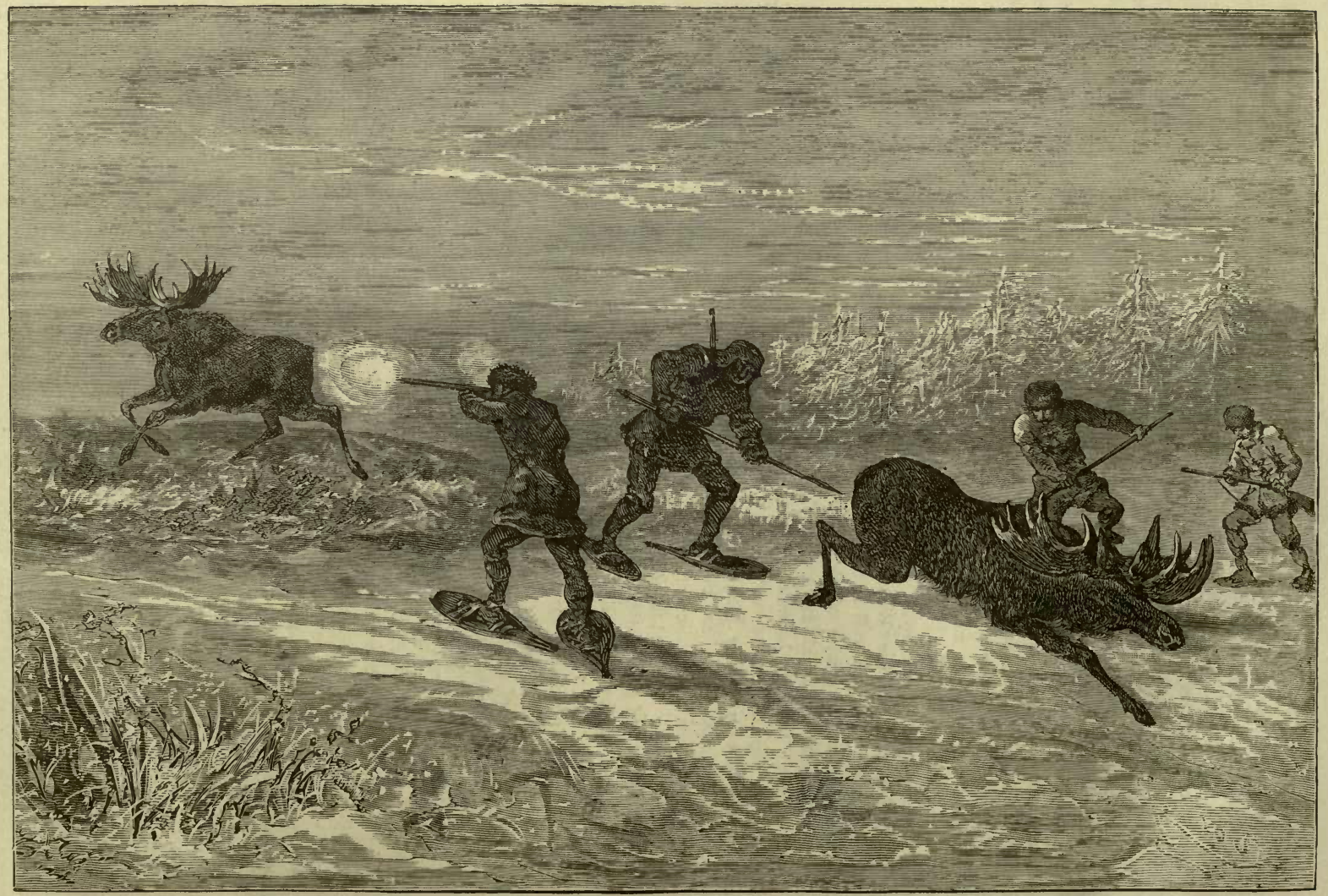
(A) Brow-tyne. (B) Tres-tyne. (C) Royal-tyne.

The Rusine type (1), in which the brow-tyne (A) is simple, at the same time that the beam ends in a simple bifurcation, is found in the Sambur Deer (*Rusa Aristotelis*) of India. The Rucervine type, in which the bifurcate beam is further subdivided, tends to be prolonged in the direction of the tres-tyne (B), at the same time that there is a corresponding reduction of the royal (C). In Schomburgk's Deer (*Rucervus Schomburgki*) of Siam, both branches of the beam are equally developed (2); in the Swamp Deer (*Rucervus Duvaucelli*) of India (3), the tres (B) is larger than the royal (C); whilst in Eld's Deer (*Rucervus Eldi*) (4), of Burmah, there is but a small snag (C) at the back of the enormous tres-tyne (B) to represent the royal. The Red Deer (*Cervus elaphus*) (6), besides having the brow-tyne (A) re-duplicated, has the royal (C) developed at the expense of the tres (B), and much divided up in well-grown animals. In the Japanese Deer (*Cervus sika*) (5) and its allies the relative proportions of the tynes are much the same, although the brow-tyne (A) is simple.

THE ELK, OR MOOSE DEER.*

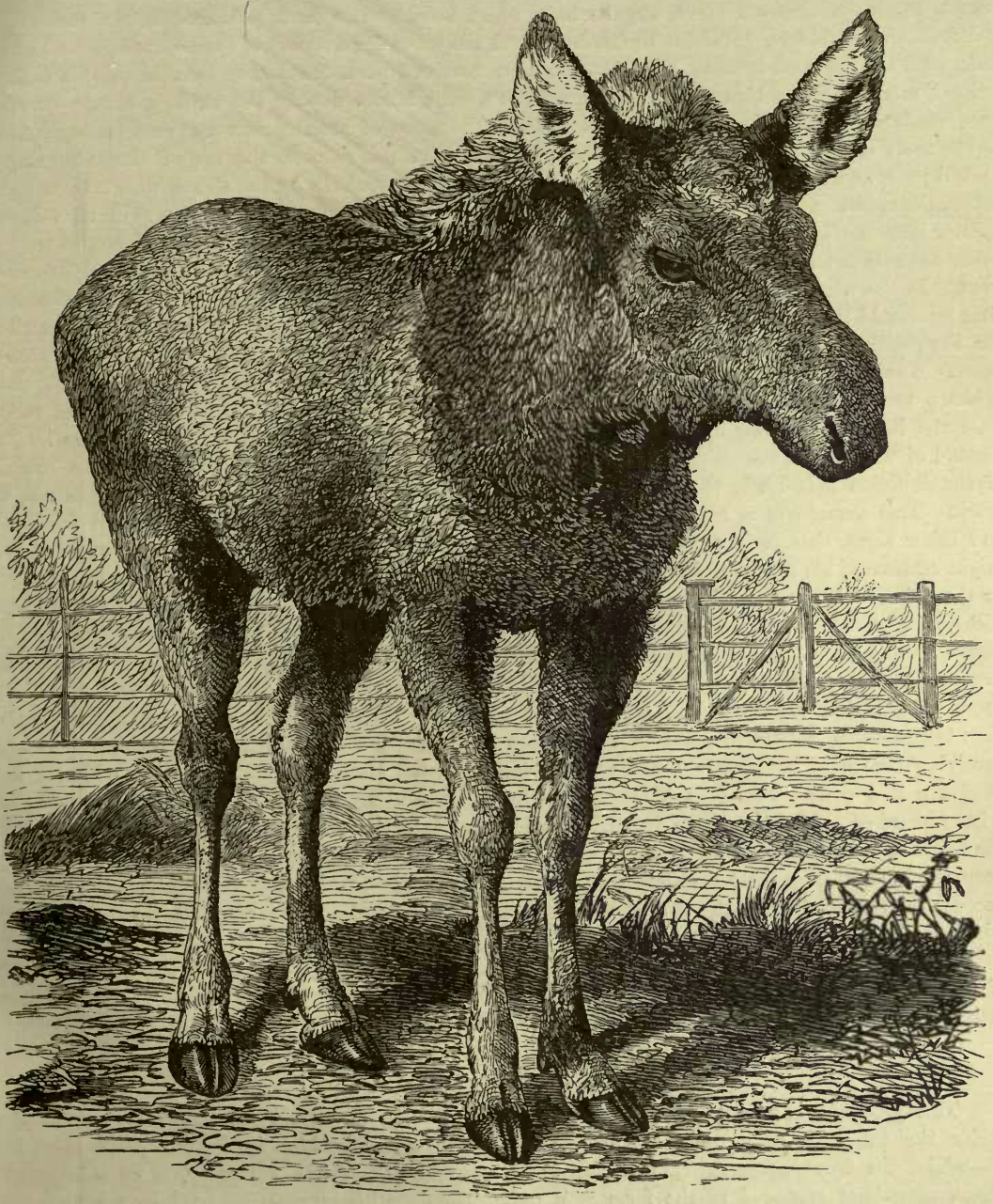
The Elk, the largest of the family of the *Cervidæ*, is found in North America, Northern Europe, and the coldest parts of Asia, thinly scattered in all but the first-named locality. At the

* *Alces machlis.*



ELK HUNT.

shoulder it may attain so great a height as eight feet when adult. The female is antler-less. In the male these appendages possess quite a peculiar shape, the two together forming a kind of basin,



YOUNG ELK.

on account of their being developed into huge palmated concave sheets of bony tissue, which diverge laterally from the skull.

At nine months old the antlers first appear, not being more than straight and rounded dags in the first year. They reach their full length in the fifth year, from which period for many more years they increase in breadth and weight, and add, it is said, a fresh point to their palmated margins until the fourteenth, when the creature is considered quite adult.

The colour of the animal is a deep blackish-brown; the neck is short and thick, with a peculiar bob-shaped, pendulous, and hair-covered lap of skin hanging down from its middle, just behind the angles of the jaw. The limbs, especially the front ones, are long; the tail is rudimentary. The coat is formed of close-set harsh angular hair, which breaks when bent, produced into a mane upon the neck and shoulders. Sir John Richardson gives the following account of the habits and food of the Elk, with the mode of hunting it:—"In the more northern parts the Moose Deer is quite a solitary animal, more than one being very seldom seen at a time, unless during the rutting season or when the female is accompanied by her fawns. It has the sense of hearing in very great perfection, and is the most shy and wary of all the Deer species, and on this account the art of Moose-hunting is looked upon as the greatest of an Indian's acquirements, particularly by the Crees, who take to themselves the credit of being able to instruct the hunters of every other tribe. The skill of a Moose hunter is most tried in the early part of the winter; for during the summer the Moose, as well as other animals, are so much tormented by Mosquitoes that they become regardless of the approach of man. In the winter the hunter tracks the Moose by its footmarks in the snow, and it is necessary that he should keep constantly to leeward of the chase, and make his advance with the utmost caution, for the rustling of a withered leaf or the cracking of a rotten twig is sufficient to alarm the watchful beast. The difficulty of approach is increased by a habit which the Moose Deer has of making daily a sharp turn in its route, and choosing a place of repose so near some part of its path that it can hear the least noise made by one that attempts to track it. To avoid this, the judicious hunter, instead of walking in the animal's footsteps, forms his judgment from the appearance of the country of the direction it is likely to have taken, and makes a circuit to leeward until he again finds the track. This manœuvre is repeated until he discovers by the softness of the snow, in the footmarks and other signs, that he is very near the chase. He then disencumbers himself of everything that might embarrass his motions, and makes his approach in the most cautious manner. If he gets close to the animal's lair without being seen, it is usual for him to break a small twig, which, alarming the Moose, it instantly starts up, but not fully aware of the danger, squats on its hams and waits a minute before setting off. In this posture it presents the fairest mark, and the hunter's shot seldom fails to take effect in a mortal part. In the rutting season the bucks lay aside their timidity, and attack every animal that comes in their way, and even conquer their fear of man himself. The hunter then brings them within gunshot by scraping on the blade-bone of a Deer, and by whistling, which, deceiving the male, he blindly hastens to the spot to assail his supposed rival. If the hunter fails in giving it a mortal wound as it approaches, he shelters himself from its fury behind a tree, and I have heard of several instances in which the enraged animal has completely stripped the bark from the trunk of a large tree by striking with its fore-feet. In the spring time, when the snow is very deep, the hunters frequently run down the Moose on snow-shoes, which give them immense advantage, because the slender legs of the animal sink into the snow for their whole length each step they take, which makes their progress very slow."

The usual pace of the Moose is a high shambling trot, and its strides are immense. On account of their necks being short at the same time that their legs are long, they browse upon the bushes rather than on the ground, which they find difficulty in reaching with their mouths.

THE ELAPHINE DEER.*

This group is characterised by the presence of a bez-tyne in all its members—except that under the influence of protracted bad nutrition individuals resident in barren parts may lose it—whilst the tres-tyne is small, and the third main branch of the antler splits up into several snags, sometimes arranged in the form of a cup. The deep brown coat is varied by a conspicuous light, almost white patch upon the rump, in which the uncovered rudiment of a tail is included. All the species are large, the best known to us being

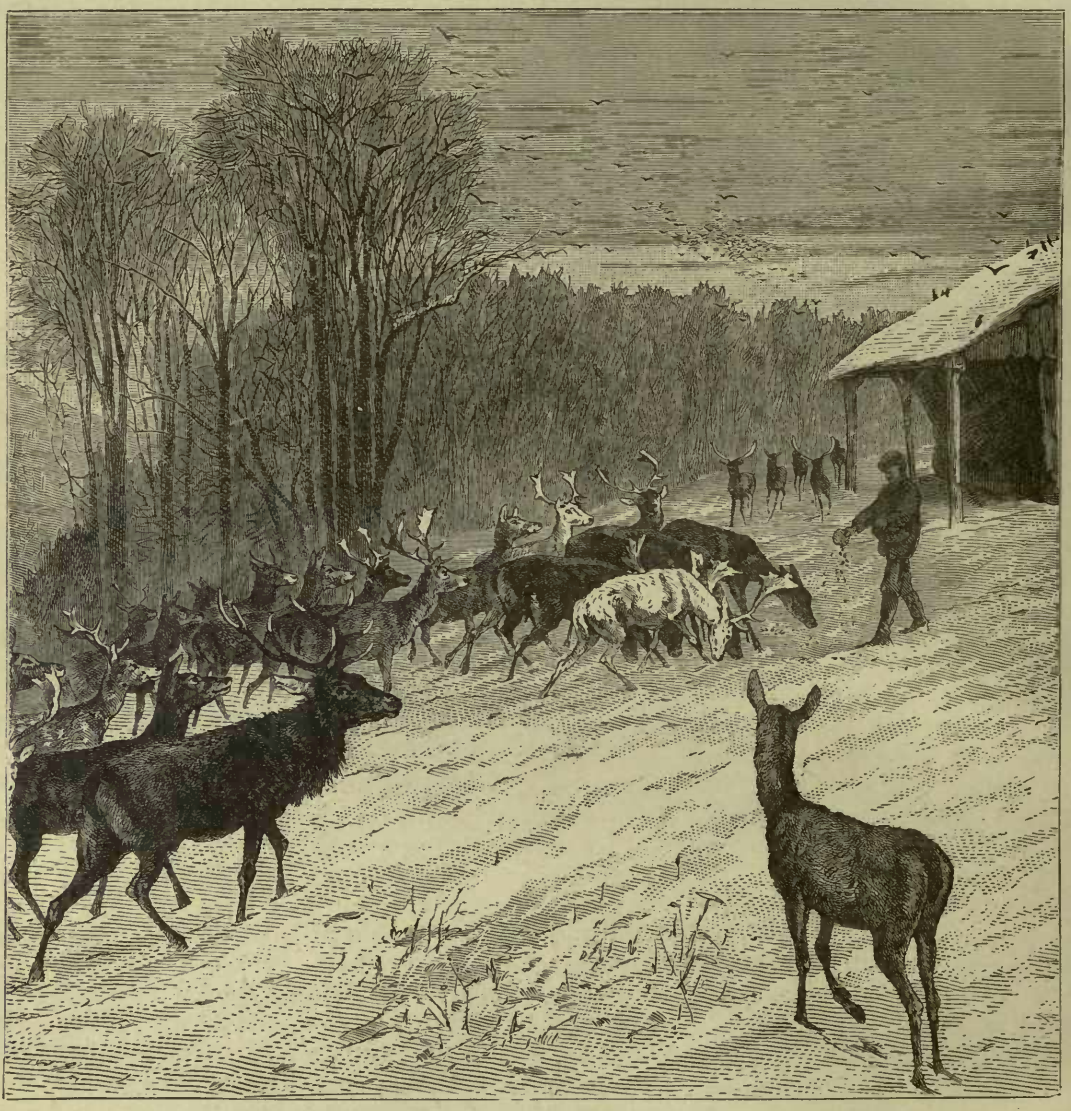
THE RED DEER.†

This species is a native of the British Isles and many parts of Europe. Northern specimens

* The restricted genus *Cervus*. † *Cervus elaphus*.

are much the smaller, and carry far inferior antlers, those of South Germany and Hungary possessing heads worthy of the species. In England they are still to be found wild in Exmoor Forest, in Scotland north of the Forth and Clyde; and in Ireland about Killarney, Connemara, and Erris.

A well-grown Stag stands over four feet at the withers, with a thickly-coated neck of a greyish tint, a rich red-brown body-colour, uniformly curved symmetrical antlers, and head held



RED DEER AND FALLOW DEER IN WINTER.

high. The Stag in summer is a lordly creature. In winter its coat is longer and of a greyer tint. As is the case in allied species, and all but a few of the Rusine Deer, the new-born calves are brilliantly spotted with white.

The pairing season occupies the early part of October. The calves are born at the end of May or the beginning of June; whilst the Stags drop their antlers between the end of February and the earlier days of April, the youngest latest. Up till the age of twelve the animal continues to increase in bulk and strength, and it is highly probable that they do not ever much outlive twenty years, although superstition credits them with very many more.

It is towards the end of August or the beginning of September that the well-nourished Stags, having already cleared their antlers of their "velvet," leave their retirement, and with swollen necks as well as restless mien, seek out the hinds. During the rutting season, which lasts about three weeks, they eat but little, and lose weight rapidly, to be regained in the subsequent repose upon the summer-developed foliage. In the southern counties of Great Britain the hunting of the Stag has degenerated into the repeated chase of a few individuals, deprived of their antlers, and let out of boxes shortly before the sportsmen put in an appearance; whilst long-ranged rifles have reduced the difficulties of what not many years ago —more especially in Scotland— was a form of sport which very severely taxed the physical capacities of the most determined and courageous.

RED DEER FIGHTING.

The Wapiti, the Persian, the Cashmerian, and the Barbary Deer resemble the Red Deer in almost every detail except size, the first and second being considerably larger. Their antlers all branch in the same manner, except that the proportionate sizes of some of the snags are apt to vary. Superb heads of Wapiti are numerous in Great Britain, with their brown beams and white burnished tips.

The Wapiti is kept in confinement without difficulty, although in autumn the stags become savage. Its home is the woodlands and the mountains of North America, where it is generally incorrectly called the "Elk." Stalking the species is a common sport, but there is not so much interest associated with it as with Moose-stalking, because it is a more stupid creature, and its senses are less acutely developed. When started, a herd will make off for a short distance, and stop to recognise the source of danger before continuing its flight. Its food is mostly leaves of trees and shrubs, though it frequently eats grass and weeds. Dr. J. D. Caton, of Ottawa, Illinois, who has had much experience in the preserving of American Deer, has published many interesting details with regard to this species. Among others he mentions, with reference to the young, that "the most prominent instinct of the young fawn is that of deception. I have several times come across fawns evidently but a few hours old, left by the mother in supposed security. They affect death to perfection, only they forget to shut their eyes. They lie without a motion, and if you pick them up they are as limp as a wet rag, the head and limbs hanging down without the least muscular action, the bright eye fairly sparkling all the time." The venison is excellent; it is said to be more nutritious than any other meat.

The Persian Deer, or Marāl, differs from the Cashmerian Deer but little. Its head, however, is longer and more pointed.

The Cashmerian Deer, or Barasingha, again, is hardly distinguishable from the Wapiti. Professor Leith Adams remarks, with reference to it, that "the Cashmere forests seem the head-quarters of this species on the western ranges, for it is seldom, if ever, met with between Mussouree and the Vale of Cashmere. The dense forests and fertile valleys of the latter country are particularly inviting to this species. In habits and general appearance the Cashmere Stag bears a striking resemblance to the Red Deer. Although it is seldom, nowadays, that individuals of the latter species escape

the hunter so long as to attain the size and magnitude of the Barasingha [twelve points], yet I think it will be found that the horns of those killed in the forests of Scotland in former years are equal in size to any at present met with in Cashmere. It is in the dense pine forests on the Northern Pinjal, and in the many beautiful valleys among these ranges, that we find the species most abundant. There are very few on the southern ranges. In the secluded depths of these solitudes they lie all day, to issue forth at dusk and feed on the grassy hill-sides, or descend even into the Valley of Cashmere when forced by the snows of winter. An adult Stag averages thirteen hands in height.

FALLOW DEER.

The colour of the coat varies but little in the sexes or the seasons of the year; dark liver-colour, with reddish patches on the inner sides of the hips; belly and lower parts white, or a dirty white. The male has the hair on the lower part of the neck long and shaggy (wanting in the female); the horns large, and usually very massive, with from ten to fifteen or more points, according to age (the largest pair of horns I have measured were four feet round the curves, with six and seven points). They are shed in March; and the new horn is not completely formed until the end of October, when the rutting season commences, and the loud bellowings of the Stags are heard all over the mountains. During vigorous winters they are frequently driven to seek for shelter and food around the villages in the valleys, when many are destroyed by natives, who hunt them with Dogs. The Cheetahs, Wild Dogs, and Bears are said to kill the young."

The very similar Barbary Deer is most interesting, in that it is the only member of the Cervine group which is found in Africa.

THE SUB-ELAPHINE DEER.*

The JAPANESE, FORMOSAN, and MANTCHURIAN DEER are all species allied to those just described, but differing in being smaller in size, at the same time that the antlers conform to the sub-elaphine type, in which the bez-tyne is never present, and the sur-royals are but inconsiderably branched. They are all strongly spotted in their summer dress, which, especially in the Mantchurian—the largest of the species—is most brilliant. In the winter their coats are nearly uniform, and of a dark brown colour. A fawn-red is the groundwork of the summer coat, the spots being yellowish-white, whilst a black streak, in perfect contrast, runs the whole length of the middle of the back, continuing

SAMBUR DEER.

down the tail and expanding slightly at its base. The throat is white. The sombre winter coat is a nearly uniform dark red-brown.

The FALLOW DEER (*Dama vulgaris*), so well known on account of its being preserved in a semi-domesticated state in so many English parks, has antlers constructed upon the same plan as those of the Mantchurian Deer (sub-elaphine). These, however, present special peculiarities found in none of the allied species, for they are palmated in their upper parts, in the region of the sur-royals, the digitations or terminal points being developed along the convex posterior margins of the palmated surface. The buck is about three feet high at the shoulder. The head is short and broad, the tail between seven and eight inches long. The colour of the wild animal, both buck and doe, is a rich yellowish-brown in summer, spotted with white all over. In winter the tints are more sombre and greyish. Domestic varieties vary immensely, both in the distinctness of the spotting and the general colouration. Until six years of age the buck receives a separate name each year from sportsmen

* The genera *Pseudaxis* and *Dama*.

—fawn, pricket, sorrel, soare, buck of the first lead, and buck complete, being the terms employed—the antlers not being developed at all in the fawn, being simple snags in the pricket, with two front branches in the sorrel, with slight palmation of the extremity of the beam in the soare, and the whole antler larger and larger until the sixth year. The venison of the Fallow Deer is fatter than that of the Red Deer, and is preferred by most.

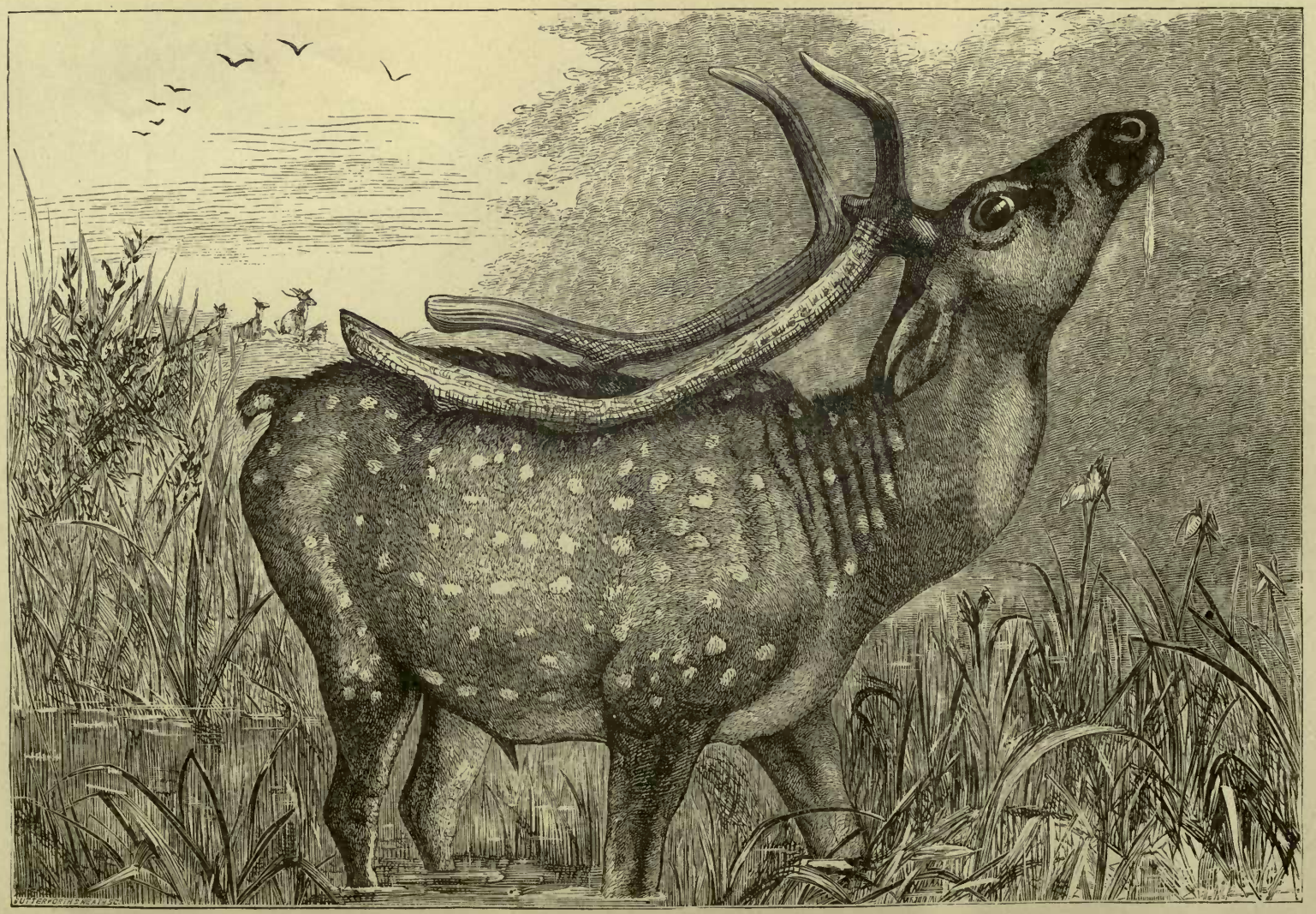
The species is not a native of Britain, having most certainly been introduced, although exactly

BORNEO RUSINE DEER.

when is not known. The dark-coloured and more hardy breed was brought from Norway by James I. Its true wild habitat was probably the shores of the Mediterranean Sea, both north and south.

The Persian Fallow Deer,* so closely related to the species just referred to that they breed together, was made known to us in 1875 by Sir Victor Brooke, who described it from specimens sent to England by Mr. Robertson, the British Vice-Consul at Busrah. It resembles the Common Fallow Deer in almost every detail, except that it is slightly larger, and that the antlers are not the same. As stated above, in the Common Fallow Deer the antlers, whilst developed on the sub-elaphine type, are palmated in the region of the royals, with several snags projecting from the upper margin, at the same time that the lower portion of the beam, the tres, and the brow-tynes are cylindrical, as usually is the case in other species.

* *Dama mesopotamica.*



AXIS DEER.

In the Persian Fallow the palmation at the extremity of the antlers is much less conspicuous, and scarcely exists, although many snags are present there, directed upwards. The palmation is at the bases of the antlers instead, including the brow-tyne and the beam, so that the general appearance of the antlers is quite peculiar to the species.

THE RUSINE DEER.*

The SAMBUR, OR GEROW (*Rusa Aristotelis*), of India, is found abundantly in all the hill-districts of that country. It is nearly five feet high, of a deep brown colour, with the hair of the neck developed almost into a mane. The tail is of fair length. Its build is massive, as are its antlers, which present three powerful points, and reach over three feet in length. Above the considerable brow-tyne the beam bifurcates high up into two fairly equal snags, and no more in well-grown antlers. The hind is much less massive, and of a yellowish tint. Captain Kinloch says of the species that "Sambur delight in stony hills, where there is plenty of cover, and where they can have easy access to water. They browse more than graze, and are nearly nocturnal in their habits. During the daytime they seek the most shady retreats, and old Stags especially are most difficult to find, frequently betaking themselves to almost inaccessible places, where the uninitiated would never dream of looking for them. The experienced hunter, indeed, has frequently to depend more upon fortune than his own knowledge of woodcraft." In Java an almost identical species differs mostly in having the hinder of the two branches of the beam of the antler longer than the one in front. Swinhoe's Deer from Formosa is also almost indistinguishable, at the same time that Sumatran and Bornean specimens agree with it in being particularly dark in colour.

Three smaller species, with antlers branched in exactly the same manner, are found in the islands of Borneo, Timor, Ternate, and the Philippines.

The HOG DEER of India and Ceylon is not bigger than the Roebuck although the legs are shorter and the body heavier. Its antlers consist of a brow-tyne and bifurcate beam, of which the posterior tyne is short, and turned inwards; they rarely exceed a foot and a half in length. It is of a uniform dark brown colour, rarely spotted indistinctly with white. Their name is derived from the pig-like way in which they run, with their heads low, when pursued.

The SPOTTED HOG DEER is a rare species, of a slightly lighter colour, and with pale yellow spots.

The AXIS DEER of India, sometimes called the Cheetal, resembles the Fallow Deer in size and colouration most closely, although its antlers serve to show that its true relations are quite different. These latter are not palmated at all, and are quite rusine in type, presenting the three points characteristic of them, the front tyne of the bifurcate beam being of great length. There is a beauty in the intensity of the spotting of the coat of this species which is unequalled by any other member of the Cervidæ, and it is interesting to know that according to the universal testimony of sportsmen, the effect of sunlight through foliage so much resembles it that it is almost impossible to recognise the animal in the woods. They have a reputation for being indolent, as they feed during the night, and sleep throughout the day, frequenting the heavy grass jungles along the banks of rivers. Their cry is a shrill bark at the approach of danger. The accompanying figure (see Plate 26), drawn from a specimen in captivity, gives an excellent idea of the immense length attained by the antlers, which in this particular case are blunt-tipped, because not quite fully grown. The hinder tyne on the right side, it will be noticed, is almost entirely hidden in the hair of the flank.

PRINCE ALFRED'S DEER,† about the size of the Fallow Deer, was first described by Dr. Sclater from a specimen brought from the Philippine Islands by the Duke of Edinburgh in 1870. Its glossy coat is of a rich chocolate colour, covered with pale yellow spots; a broad line along the back, as in all spotted Deer, being uninterrupted; the under parts are of a pale yellow. The antlers are only nine inches in length, but comparatively thick, and simply branched upon the rusine type, with three points. The legs are rather short, at the same time that the body is heavy.

The SWAMP DEER.‡ The name Barasingha, signifying "twelve points," is applied to two very different species of Indian Deer, the Cashmerian Deer, previously mentioned, and the Swamp Deer.

The Swamp Deer of India and Assam is slightly smaller than the Sambur, not exceeding four

* The genus *Rusa* and its allies. † *Rusa Alfredi.* ‡ *Rucervus Duvaucelli.*

SCHOMBURGK'S DEER.

feet in height. Its colour is a rich light yellow. As its name signifies it delights in moist situations, where it congregates in herds of great numbers. Its antlers are large, and of the intermediate rucervine type. The brow-tynes reach a foot in length, and are directed forwards with an upward turn at their tips. The beam is long, and branches into an anterior, massive, and branched continuation of itself, as well as a posterior smaller bifurcate tyne.

In Siam this species is replaced by the closely-allied SCHOMBURGK'S DEER, a little-known species, in which the antlers are extremely elegant, the long brow-tyne being followed by a short beam which bifurcates into two equal branches, these again, each of them, bifurcating in a similar manner.

ELD'S DEER, OR THE THAMYN.* This Deer, which differs from the Swamp Deer only in its antlers, was discovered by Captain Eld, in 1838. It abounds in the swamp lands of Burmah, and extends as far east as the Island of Hainan. Its form is slimmer than that of the Red Deer, at the same time that it is somewhat smaller, attaining a height of over four feet. During the summer months its body-colour is a light rufous brown, with a few faint indications of white spots. Its under parts are nearly white, as are the insides of the hairy ears. Its tail is short, and black above. In winter its lengthy hair takes on a darker tint.

Lieutenant R. C. Beavan has given an excellent account of the habits of Eld's Deer, from which we learn that their food must consist almost entirely of grass and paddy, which grow both cultivated and wild, in the swamps in which they dwell. "In habits they are very wary and difficult of approach, especially the males. They are also very timid, and easily startled; the males, however, when wounded and brought to bay with Dogs, get very savage and charge vigorously. On being disturbed they invariably make for the open, instead of resorting to the heavy jungle like Hog Deer and Sambur. In fact the Thamyn is essentially a plain-loving species; and, although it will frequent tolerably open tree-jungle for the sake of its shade, it will never venture into dense or matted

* *Rucervus Eldi.*

underwood. . . . When first started the pace of the Thamyn is great. It commences by giving three or four large bounds like the Axis or Spotted Deer, and afterwards settles down into a long trot, which it will keep up for six or seven miles on end when frequently disturbed." As to the means employed to hunt them, the same author informs us that "a large number of men would assemble from the neighbouring villages, and gradually encircle three or four moderate-sized herds with long strings, upon which plantain-leaves were tied so as to flutter in the wind. The circle, originally formed at some distance, was gradually lessened as the Deer, afraid to pass the scarecrows, got gradually driven together, until they were completely surrounded and at the mercy of the hunters. The object was to get them into a corner near the heavy jungle, into which, if they attempted to run, they either became entangled, or allowed their pursuers to get up quite close. As many as a hundred and fifty to two hundred, my informant tells me, he has himself seen killed in one battue in former years. To such a length was this [shameful] system carried, and such enormous havoc was thereby created, that the Burmese Government, fearing the species would be utterly exterminated, wisely put a stop to the practice."

CHAPTER V.

THE MUNTJACS—THE ROEBUCK—CHINESE DEER—REINDEER—AMERICAN DEER—DEERLETS—CAMEL TRIBE—LLAMAS.

THE MUNTJACS—Distribution—Characters—THE INDIAN MUNTJAC, OR KIDANG—Hunting—THE CHINESE MUNTJAC—Habits—DAVID'S MUNTJAC—"Shanyang"—THE ROEBUCK—THE CHINESE WATER DEER—Peculiarity—Chinese Superstition regarding it—THE CHINESE ELAPHURE—Peculiarity of its Antlers—THE REINDEER—Distribution—Character—Colouration—Antlers—Canadian Breeds—Food—THE AMERICAN DEER—THE VIRGINIAN DEER—THE MULE DEER—THE BLACK-TAILED DEER—THE GUAZUS—THE BROCKETS—THE VENADA, OR PUDU DEER—THE CHEVROTAINS, OR DEERLETS—Antlerless—Their Position—Bones of their Feet—General Form and Proportions—Species—THE MEMINNA, OR INDIAN DEERLET—THE JAVAN DEERLET—THE KANCHIL—THE STANLEYAN DEERLET—THE WATER DEERLET—THE CAMEL TRIBE—Their Feet—Stomach—Its Peculiarity—The Water Cells—THE (TRUE) CAMEL—Description—The Pads of Hardened Skin—Its Endurance—Its Disposition—Anecdote of its Revengeful Nature—THE BACTRIAN CAMEL—THE LLAMAS—Description—Habits—Used as Beasts of Burden—Wild and Domesticated Species—THE HUANACO—THE LLAMA—THE VICUNA—THE ALPACA—The Alpaca Industry—FOSSIL RUMINANTIA—Strata in which they are found—*Chœropotamus—Hyopotamus—Dichobune—Xiphodon—Cainotherium—Oreodon—Sivatherium*—Fossil Deer, Oxen, Goats, Sheep, Camels, Llamas, Antelopes, Giraffes—The Irish Elk—Its huge Antlers—Its Skeleton—Ally—Distribution.

THE MUNTJACS.*

THE Muntjacs form a group of small and elegant Deer found in India, Burmah, China, the Malay Peninsula, and the large islands of the Indo-Malay Archipelago. They differ from all other members of the family in that their diminutive antlers are supported on lengthy bony pedestals, covered with a hairy skin much like the horn-processes of the Giraffe. Most, also, have a pair of elongated longitudinal ridges between the eyes, within the folds of which small glands are situated, at the same time that there is a dark crest of retroverted hair, tending to the shape of a horseshoe, upon the forehead. In the males the upper canine teeth develop into tusks, which project externally some way below the lip, though not so far as in the Musk, forming efficient instruments of attack.

The INDIAN MUNTJAC, OR KIDANG, is the best known species. Its antlers attain a larger size than those of any of the others, although they are not more than four inches long, composed of an undivided beam, at the base of which there is a diminutive brow-tyne. Its size is slightly less than that of the Roebuck, its colour uniformly foxy red-brown, with the throat, hind part of abdomen, and under surface of tail white. A black line runs up the inner side of each antler-pedestal of the male, instead of forming the frontal horseshoe of the female.

Dr. Horsfield tells us that in Java, where it is much hunted, "the Muntjac selects for its retreat

* The genus *Cervulus*.

certain districts, to which it forms a peculiar attachment, and which it never voluntarily deserts. Many of these are known as the favourite resort of the animal for several generations. They consist of moderately elevated grounds, diversified by ridges and valleys, tending towards the acclivities of the more considerable mountains, or approaching the confines of extensive forests. . . . . The Muntjac has a strong scent, and is easily tracked by Dogs. When pursued it does not go off, like the Stag, in any accidental direction; its flight, indeed, is very swift at first, but it soon relaxes, and taking a circular course, returns to the spot from which it was started. After several circular returns, if the pursuit be continued, the Kidang thrusts its head into a thicket, and in this situation remains fixed and motionless, as if in a place of security, and regardless of the approach of the sportsman."

In China the Muntjacs are smaller than those of India and Java; their antlers are less

INDIAN MUNTJAC.

developed at the same time that the tint of their coats is less rufous, and the neck is not white. They were first described by Mr. Ogilby under the name of Reeves' Muntjac, a larger form having been more recently discovered by M. A. Milne-Edwards and Mr. Swinhoe. With reference to its habits the last-named naturalist tells us that "this species affects the low ranges of hills which are covered with long, coarse grass and tangled thicket. It is there usually found in small herds, basking in the sun, or lying in hidden lairs. They are very seldom approached near, except by stealth. The least noise startles them, and they dash away with bounds through the yielding grass, occasionally showing their rounded backs above the herbage. They have, however, their regular creeps and passes through the covert, near which the natives lie when stalking them, while others drive them. The little startled creatures hurry from danger along these beaten tracks, and are then picked off with the matchlock." In captivity they soon become very docile, even when taken in the adult state. The flesh of this animal is very tender and palatable.

The enterprising missionary Père David, among his numerous discoveries in Chinese zoology, sent from Moupin, in Western China, to Paris, skins of a peculiar Muntjac, which is of special interest. Having canine tusks, a black frontal hairy horseshoe, and the proportions of a Muntjac generally, its antlers are not more than an inch long, at the same time that their pedestals are

correspondingly reduced in length as well as thickness. Its body-colour is mouse-brown, verging on grey, whilst the hairy covering is coarse. It may be called DAVID'S MUNTJAC.

Very shortly after the above-mentioned skins arrived at Paris, Mr. Michie, of Shanghai, forwarded to Mr. Swinhoe in England another specimen from Ningpo, which, although derived so far east of Moupin, is almost indistinguishable from that belonging to the latter district. The animal is there known as the "Shanyang," or Wild Goat. It is an undoubted Muntjac, although peculiar in not possessing the glands on the forehead found in the more common species.

THE ROEBUCK.*

This elegant, small, and almost tailless Deer is, like the Red Deer, a native of Great Britain, as well as of all Northern Europe and Asia below the line of perpetual snow. In Asia the individuals attain a greater size than in Europe. The adult Roebuck stands a little over two feet high

ROEBUCK: MALE, FEMALE, AND YOUNG.

at the shoulder. Its colour is a dark reddish-brown in summer, becoming yellowish-grey in the cold weather. There is a large patch of white on the rump. The antlers, which are peculiarly near together at their bases, rarely exceed a foot in length, possessing three points, the rugose unbranched beam continuing from the considerable burr for half a foot unbranched; then bifurcating fore and aft, the posterior branch again bifurcating. The destruction of the forests throughout Britain has driven the Roebuck farther north, till now it is most common in the north of Scotland, although it still survives in the woods of Westmoreland and Cumberland. Its disposition is wild, shy, and cautious. Its favourite resort is the thick underwood of forests, living singly or in small companies of a pair with their young, which latter—contrary to what we find in the case of most other Deer—are two or three in number. Its venison makes very indifferent food.

THE CHINESE WATER DEER.†

This is an entirely isolated small species, not bigger than an Indian Muntjac, discovered by Mr. Swinhoe, *in which there are no antlers*, the canine teeth of the upper jaw being developed into immense tusks which project downwards, as in the Musk and Muntjacs. The legs are short, and

* *Capreolus caprea.* † *Hydropotes inermis.*

the body lengthy. The body-colour is a light red-brown all over. There is no tuft of hair on the head as in the Muntjacs, to which by some it might be imagined to be allied. From Mr. Swinhoe's account of the species we learn that "In the large riverine islands of the Yangtsze, above Chinkiang, these animals occur in large numbers, living among the tall rushes that are there grown for thatching and other purposes. The rushes are cut down in the spring; and the Deer then swim away to the main shore and retire to the cover of the hills. . . . Fortunately for the Deer, the Chinese have an extraordinary dislike for their flesh. I could not ascertain why; but it must be from some strange superstition, as the Celestials are otherwise pretty omnivorous. The Deer are killed only for the European markets [of Shanghai], and sold at a low price. Their venison is coarse, and without much taste. . . . . The Chinese at Shanghai call this animal the *Ke*, but at Chinkiang they are named *Chang*—the classical term for the Muntjac."

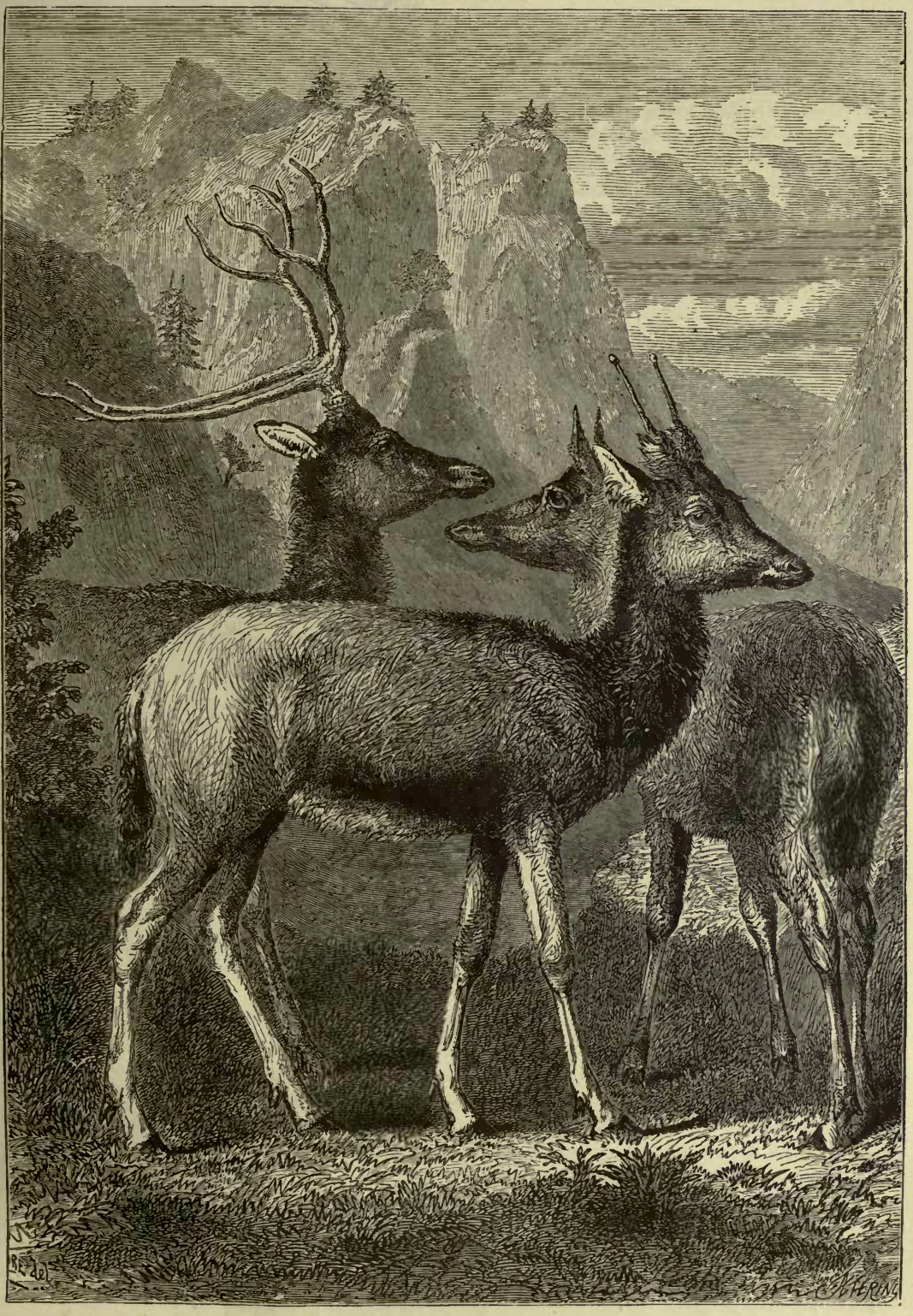
CHINESE WATER DEER.

THE CHINESE ELAPHURE.*

This most interesting Deer was discovered in 1865 by the indefatigable French naturalist, M. Armand David. In his account of the animal, Dr. Sclater † tells us that M. David first observed it whilst looking over the wall of the Imperial Hunting-park at Pekin, to which no European is allowed admission. There it is found in a semi-domesticated state, its native place probably being Eastern Mantchuria. In 1869, Sir Rutherford Alcock succeeded in sending a living pair to England, which were exhibited for some time in the London Zoological Gardens, and from which much information has been obtained with reference to their habits. It resembles the Swamp Deer of India (*Rucervus Duvaucelli*) in its proportions and size, standing nearly four feet at the shoulder. The legs are somewhat heavy and the feet expanded, but it is in its antlers that the Elaphure is quite different from any other Deer. They are represented in the accompanying engraving, from which the abrupt ascent of the beam, with an enormous back-tyne arising from the lower end, and no brow-tyne, may be most clearly seen. The beam branches higher up, but its furcations follow none of the ordinary rules of cervine antler-growth.

The body-colour of the animal is light and rufous, paler on the under parts. A black line runs some way down the back, being most conspicuous at the shoulders. The tail is not longer than in the Fallow Deer, and is hairy at the tip. Mr. Swinhoe tells us that the Chinese name is Sze-poo-seang, which signifies "like none of the four"—to wit, the Horse, the Cow, the Deer, or the Goat.

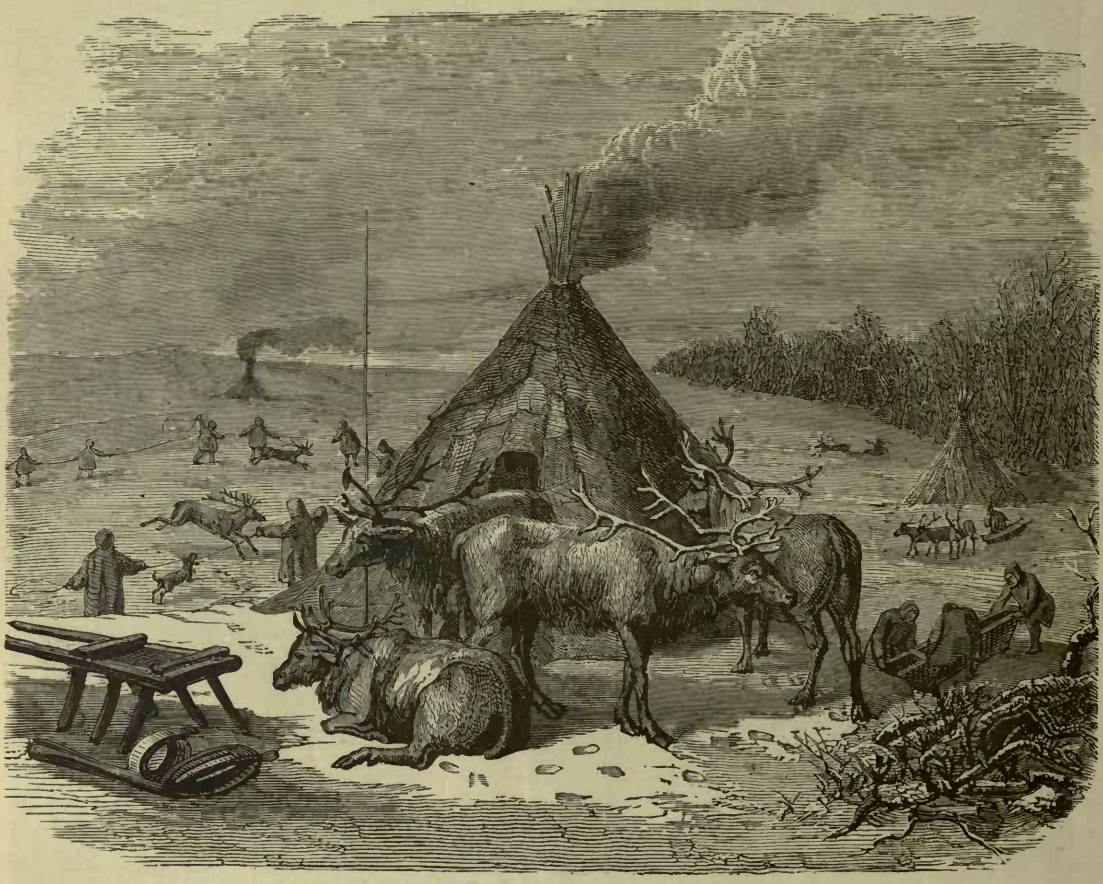
* *Elaphurus Davidianus.* † *Transactions of the Zoological Society*, Vol. VII. p. 333.



CHINESE ELAPHURE.

THE REINDEER.*

The Reindeer, which differs from all its allies in that the females carry antlers as well as the males, forms so important an element in the social economy of the Laplanders that more has been written on its habits than of any other species of the family. It is found distributed throughout the Arctic regions of Europe, Asia, and America, extending farther south in the last-named of these in the same way as the isothermal line of 32° Fahr., as might be expected from the relation borne by its economy to its temperature. In Spitzbergen, Finland, and Lapland it attains the



REINDEER AT A LAPP ENCAMPMENT.

greatest size, being inferior in strength and stature in Norway and Sweden. In Iceland it has been introduced and thrives. The Caribou is the name by which it goes in the New World, where it extends through Greenland, Canada, and Newfoundland. The horns of the American variety differ from those of the Old World so much that it is not difficult to recognise their origin; nevertheless, attempts which have been made to establish the specific difference of the two forms have not found much favour with naturalists generally.

The animal, with a characteristic deer-like form, is powerfully built, with short limbs and heavy neck. The feet have the false hoofs well developed, while the fissure between the median toes is so much extended upwards, and the ligaments which bind them together are so loose, that their hoofs spread out considerably when pressed upon the ground, and so increase the surface for support upon the yielding snow—their most frequent foothold. Upon raising the limbs in rapid action these hoofs make a sharp snap at the moment when they close together.

* *Rangifer tarandus.*

REINDEER.

Individuals vary much in tint as well as with the season. Some are entirely white, whilst in winter the coat is always lighter than in summer. Deep brown is the prevailing tint, and there is generally a band of white above each hoof. As in the Elk—another Arctic ruminating animal—the muffle of the nose is covered with hair, and is not moist. The fur is of two sorts—an outer covering of longer, harsh, brittle hair, and an under-coat of closely-matted and much finer, wool-like texture, which serves as an excellent protection against the inclement temperature, and makes the skins so valuable for articles of clothing in the Arctic regions.

The antlers are strikingly large for the size of their owners. Although they vary considerably in detail, the general plan of their construction is always the same, agreeing with that of the Virginian Deer and the Barasingha. As in the Wapiti and Red Deer, the brow-antlers on each side are, however, re-duplicated, so that a bez is present. This, as well as the brow-tyne, is branched, or palmated, wherein it is peculiar; and further, in the Caribous one of the brow-tynes is generally aborted, in order to allow of the great development of its fellow of the opposite side into a palmated triangle, flattened from side to side, directed straight forward in the middle line of the head, and attached by its apex to the beam. The function of this share-like expansion in the economy of the animal can hardly be other than to remove the snow which covers its favourite food, each movement of the lowered head from side to side effecting this result. The beam is lengthy, curved boldly upwards and forwards, with a small snag at the back, about half-way from each end. Its extremity is branched and often palmated, much like the horns of the Fallow Deer. The beam may reach a length not more than three inches less than five feet. In the females the same plan of structure of the antlers exists as in the males. They are considerably smaller in every respect, more slender, and scarcely palmated, if at all so.

The Woodland Caribou and the Barren-ground Caribou are the names given to a larger and a smaller breed in Canada. Both are hunted by the Indians for their flesh as well as for their hides, the venison obtained from the latter being held in high estimation. The pounded meat, when mixed with melted fat, is known as pemmican. The tongue is esteemed a great delicacy.

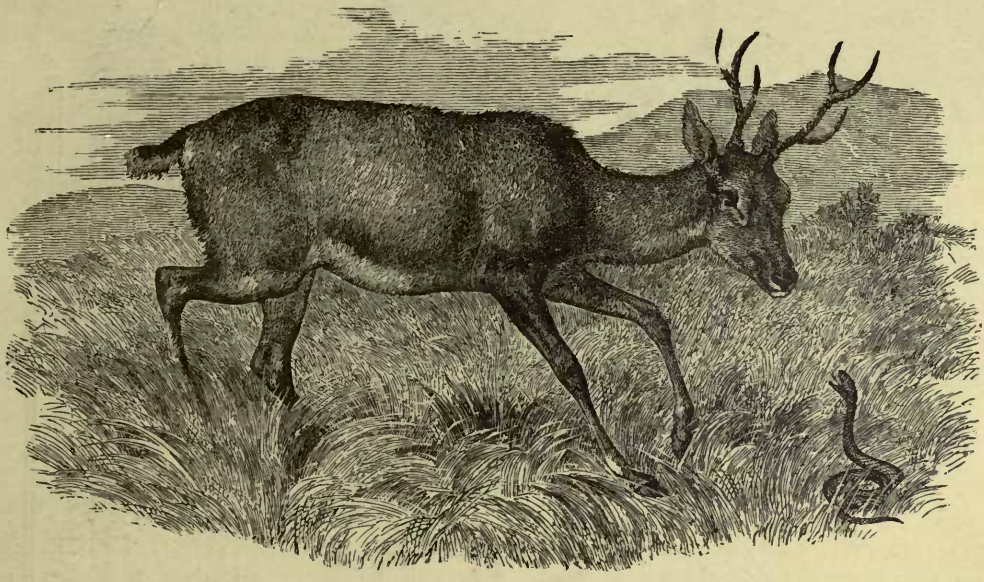
The Reindeer, from the nature of the country it inhabits, is compelled to lead a migratory life, in which the natives of Lapland, who have to depend entirely for their sustenance on the animal, have to participate. Troops of them during the winter months reside in the woods, feeding on the lichens that depend from boughs of the trees, as well as on those that grow upon the ground beneath. In the spring they repair to the mountains in order to escape the swarms of stinging Gnats and Gad-flies which infest the air, and inflict wounds in the skin of most serious severity.

THE AMERICAN DEER.

In America there are several species of Deer which differ considerably from those of the Old World. In our remarks on these animals we will not include among them the Wapiti and the Elk: the Wapiti, because it is nothing but a large representative of the Red Deer of Great Britain; the Elk, because it stands very much by itself, at the same time that it is found in the Arctic Old World as well as in America. We ourselves think that the Reindeer conforms to the American type of structure, and have therefore described it in relation with the New World Deer, although most authors class it not far from the Elk.

None of the typical Deer of America attain any considerable size, and their antlers are decidedly small when contrasted with those of the Old World. The species which will be first described is the VIRGINIAN DEER, which is the "Common" Deer of North America, and is slightly smaller than the Fallow Deer. Its colour is uniform, being of a reddish-yellow in summer and light grey in winter. The individual members of the species are small in Mexico, and get larger as they live more north. The antlers belong to the extreme rucervine type, their beams turning outwards and forwards in a very characteristic manner, with several points directed upwards from their convex border. The brow-tyne is short and pointed upwards instead of forwards. The tail is nearly a foot and a half in length. In disposition it is timid and wild, and is therefore domesticated with difficulty. Its flesh was in times gone by one of the staple articles of food of the aborigines. Audubon and other authors have described in detail the various modes employed in capturing these Deer, including the "still hunt," "jack hunt," "fire hunt," &c., according to the nature of the country.

The MULE DEER and the BLACK-TAILED DEER are not far distantly related North American species. The former is slightly larger than the Virginian and of a heavier build. Its tail is short, tufted, and white; its colour a dark grey in winter, dull yellow in summer. Its name was suggested from its lengthy ears. The latter is smaller, and has shorter legs. Its colour is tawny grey, the short tail black above and white below. Of both these species the antlers differ from the Virginian Deer in detail, only the brow tyne of the Black-tailed species being rudimentary, at the same time that the snags on the convex margin of the beam spring from a single stem instead of independently. In the Mule Deer they are smaller and less branched. Lord Walsingham, in writing of them, remarks, "They appear to frequent the thick willow clumps and other brushwood bordering the streams and swamps. They were extremely difficult to distinguish among the foliage, and remarkably quick when alarmed. As they bound off over logs and fallen trees, or dash through the thicket, they have a habit of swinging their broad white tails with a conspicuous flourish, which becomes annoying to a sportsman, to whom they never afford anything but a snap shot, which is very apt to fail."



GUAZUTI DEER.

The GUAZUS are small South American Deer with large ears and short tails, in which the antlers want the brow tyne, and have the beam branched in almost exactly the same way as Schomburgk's Deer when not quite full grown. The Guazuti, one of them, is not more than two feet six inches in height.

The BROCKETS are equally small, with minute antlers of a most simple form—whence the name—they being unbranched and shelving backwards. The colour of the fur in the Guava Viva and Brazilian Brocket is pale brown, and shining red-brown in the Red Brocket and the Eyebrowed Brocket.

The VENADA, OR PUDU DEER, is not bigger than Reeves' Muntjac or a Hare. Its colour is red-brown, and it has minute antlers, not far separated from one another. It inhabits the western coast of South America.

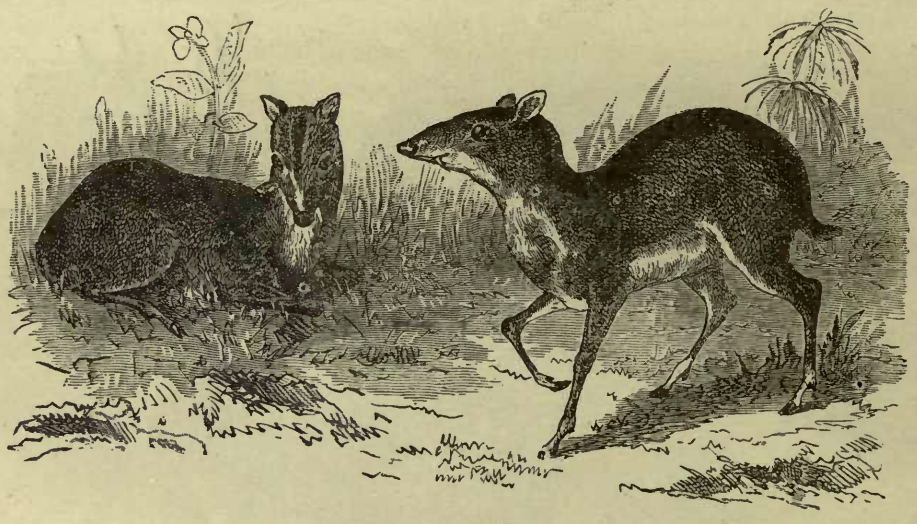
THE CHEVROTAINS, OR DEERLETS.*

It is not until within the last few years that naturalists have separated off from the true Deer a group of diminutive animals which look like them in miniature, but are entirely destitute of antlers. These little creatures, known as Chevrotains, for which we take the liberty of coining the name Deerlets, were placed together with the Musk into a single section, characterised by the fact that the males possess large tusks situated in the upper jaw, which project downwards, and are conspicuous even when the mouth is fully closed, grooving the lower lip on each side. Now,

* *Tragulidæ.*

however, they are entirely separated off from the Deer and Ox tribes, to constitute an independent family, because of the peculiarities of many of their parts. They have a complex stomach composed of paunch, honeycomb-bag, and reed, the manyplies being so much reduced in size, that it may practically be said not to be present.

From the bones of their feet it is evident, too, that they cannot be correctly classed with the more ordinary Ruminants, and that they tend towards the other family of the Cloven-hoofed Ungulata, namely, the Swine. Each foot of the common Pig possesses four toes, that corresponding to our thumb in the fore-limb, and to our great toe in the hind being absent, as has been previously explained. The bones of all these toes are quite separate from one another, as in those of man, at the same time that those of the outer and inner digits in each limb are smaller than those which bear the larger hoofs. In the true Ruminants and in the Camel tribe these larger toes are partly fused together, the bones of digit three and digit four corresponding to those situated in the human palm and sole, being joined from end to end to form the "cannon-bone;" whilst those of digit two and



JAVAN DEERLET.

digit five are reduced to mere imperfect splinters, or are sometimes altogether lost, as in the Giraffe and in the Camel. Now, in the Deerlets, these bones are not blended at all in the fore-limbs of the Water Deerlet of West Africa, in which, as in all the other species, digit two and digit five are perfect from end to end. They therefore stand, in this respect, as in others easily explained, intermediate between the Swine and the true Ruminants.

All the Deerlets are particularly delicate, diminutive, and graceful animals, the slenderness and clear-cut outline of their limbs being exceedingly striking. With bodies as big as that of a Hare or Rabbit, their legs are not so thick as a cedar pen-holder or a clay pipe-stem. Their proportions are very much those of the small Water Bucks of Africa, and of many of the kinds of Deer, especially the Hog Deer of India, in which the body, as in them, is not carried very high above the ground. The want of antlers in both sexes makes them resemble Hinds rather than Stags at first sight, whilst their elegantly-pointed noses, and large dark eyes, add to their general interesting appearance.

Of the Deerlets there are five species—the Meminna, the Kanchil, the Javan, the Stanleyan, and the Water Deerlets. The first four are confined to India, Ceylon, Malacca, Java, and Sumatra, the last being found in Sierra Leone and the Gambia district. These differ slightly in their size and markings, the Meminna, or Indian Deerlet, being nearly eighteen inches long, and about eight inches high at the shoulder, the tail being very short. As in its allies, the white spotting of the surface is disturbed by two or more streaks of the same which run along the flanks.

The Javan Deerlet, known sometimes as the Napu, is smaller than the preceding. It is of

a rust-brown colour above and white beneath, three white stripes radiating backwards, one along the middle line, and the other two laterally from the front of the neck. The short tail is white-tipped. The naked and moist muzzle is black. The Javan Deerlet is gentle in disposition, and somewhat uninteresting in captivity. Specimens are frequently brought to Great Britain, and live if carefully protected from the cold.

The KANCHIL is still smaller in size, at the same time that it is darker in colour, especially along the back. Its activity and cunning are remarkable, so much so that Sir Stamford Raffles, in his original description of the creature, tells us that it is a common Malay expression, with reference to a great rogue, that he is "as cunning as a Kanchil." Feigning to be dead when caught, its captor incautiously releases his hold, when the animal is immediately up and away before any means can

STANLEYAN DEERLET.

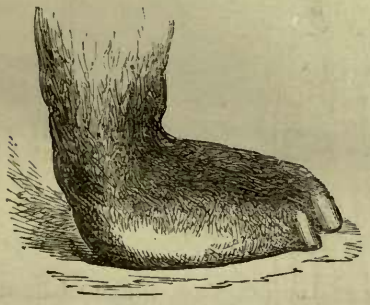
be employed for its recapture. It is also said that when pursued by Dogs it will jump up towards a bough, and there hook itself by means of its lengthy tusks until its tormentors have passed under it.

The STANLEYAN DEERLET was named after the grandfather of the present Earl of Derby, in whose menagerie at Knowsley the species was first recognised.

The WATER DEERLET of West Africa is slightly larger than the Meminna. Its deep glossy brown coat is also streaked with white lines, and is irregularly spotted.

THE CAMEL TRIBE, OR TYLOPODA.

The name *Tylopoda*, by which the Camels, together with the Llamas, are known to naturalists, is derived from two Greek words (τύλος, a knot or callus, and πούς, a foot), signifying that the feet, instead of being protected by hoofs, are covered with a hardened skin, enclosing the cushion-like soles of the feet, which are so constructed that they spread out laterally when brought in contact with the ground, an arrangement of evident advantage to desert-ranging animals. The tips of each of the two toes are protected by nails, as can be seen in the accompanying drawing.



FOOT OF CAMEL.

There are also other points in which these creatures differ from the more ordinary Ruminantia. In the front of the upper jaw there are two teeth—one on each side, placed laterally—which correspond to the side cutting teeth in man, and to

the similarly-situated "nippers" of the Horse. In the Deer, Ox, Sheep, and their allies there is not a trace of these, as has been previously explained (page 4). As to the limbs, it may also be mentioned that the true knee-joints — which in animals like the Horse are almost entirely hidden within the general skin-covering of the body —are much more conspicuous and free.

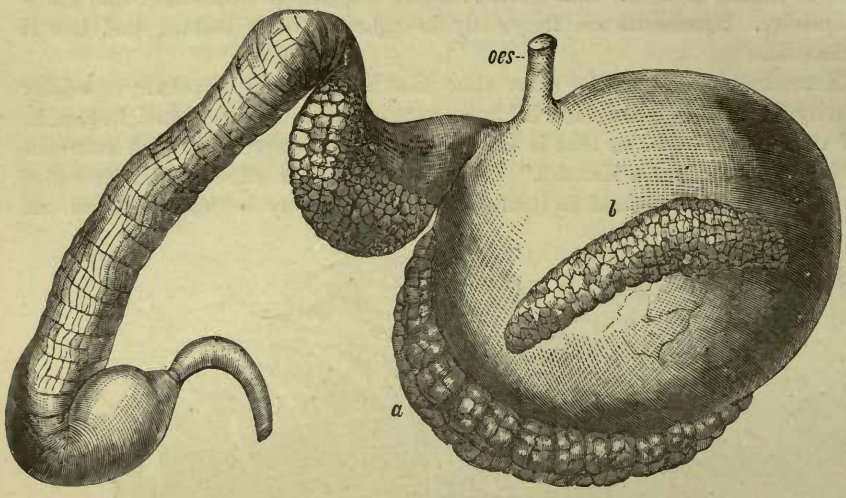


Fig. A.—STOMACH OF THE LLAMA.

The stomach is peculiar; it wants the "manyplies," or third compartment, but possesses the "paunch," "honeycomb-bag," and "abomasum," the last-named of which is of great length. In the walls of the paunch there are present two extensive collections of "water-cells," which serve their owners in good stead whilst traversing the desert or residing in regions where fresh water is not to be procured except with difficulty.

Fig. A is a view of the stomach from below (or, in other words, from the side farthest from the backbone), in which it is seen that the clusters of water-cells (*a* and *b*) are arranged, one (*a*) the larger, along part of the right border of the viscus, whilst the second (*b*) is transverse, the remainder of the walls being smooth. These water-cells, seen from within in Fig. B, are formed by the development of septa, both transverse and longitudinal, in the substance of the paunch-wall. They are deep and narrow, much like the cells of a honeycomb, and have a muscular membrane covering their mouths, in which there is an oval orifice opposite to each compartment capable of being further dilated or completely closed, probably at the will of the animal. When fully distended, these paunch-cells in the Arabian Camel are capable of storing a gallon and a half of water. The second stomach, or reticulum, is also modified in the same direction, the usually extremely shallow cells being deep, at the same time that food is

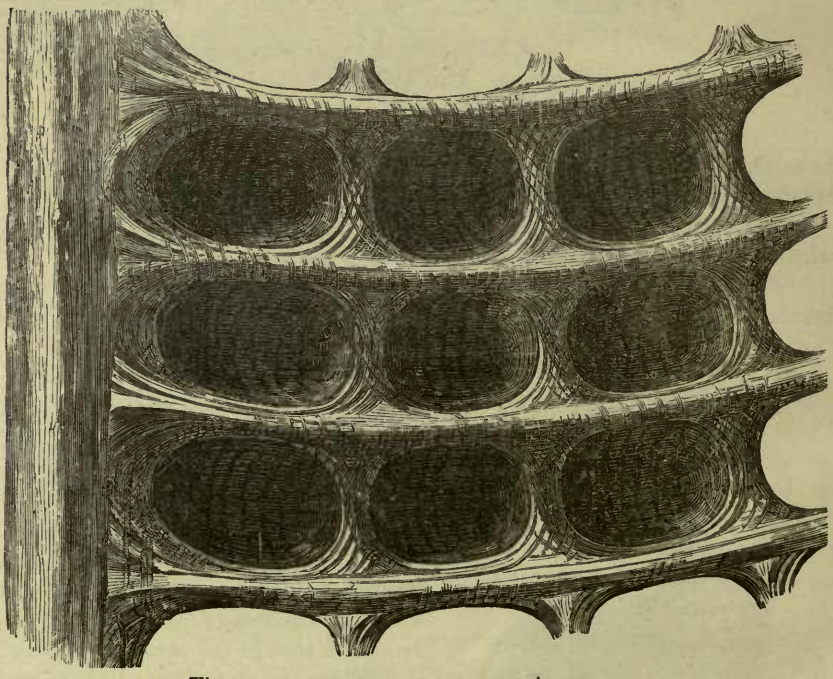


Fig. B.—WATER CELLS OF THE CAMEL'S STOMACH.

never found in them after death. Of the last compartment, or "abomasum," it may be noted that it is nearly cylindrical in shape, its walls being very muscular. It is in this stomach that true digestion is carried on.

Of the Camels two species are known, differing in the number of the humps upon their backs. Nothing is known of either variety in the wild state. We will commence with the description of

THE (TRUE) CAMEL.*

The One-humped Camel of Arabia is frequently termed the Dromedary, but this latter name

HEAD OF THE (TRUE) CAMEL.

is correctly applicable only to the swift variety of the species which is employed for riding, the heavier-built One-humped Pack-Camel not being included under the designation.

It is the Arabian Camel—the *Ship of the Desert*—which is much more serviceable to man than its Bactrian ally. Its distribution has extended westwards along North Africa, from which attempts have been made to introduce it into Spain. Eastwards it is found as far as India.

In the Camel the limbs and neck are lengthy. A single bulky hump is present on the middle of the back, composed of fatty cells held together by strong bands of fibrous tissue which cross in all directions. Like all similar accumulations, it varies much in size according to the condition of the animal, dwindling almost to nothing after protracted hard work and bad feeding, being firm and full in times of ease and plenty. When on the point of commencing a long journey, there

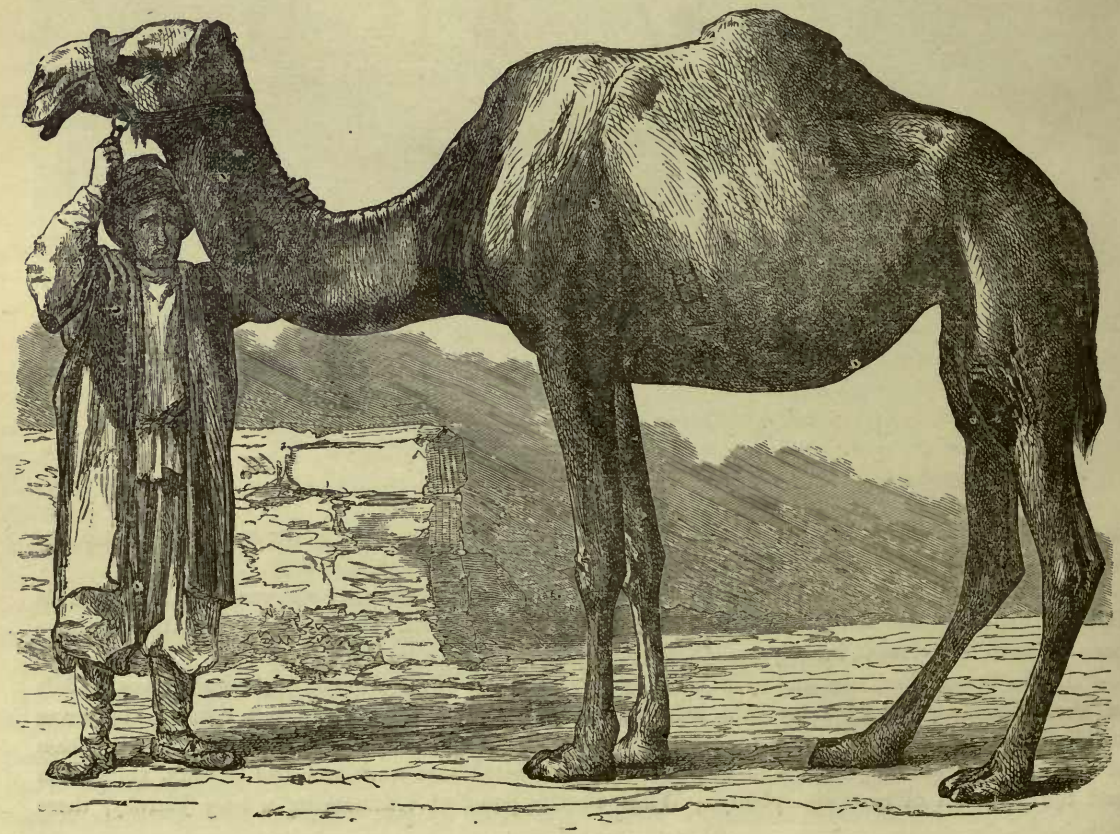
* *Camelus dromedarius.*

is nothing on which an Arab lays so much stress as on the condition of his Camel's hump, which, from what we have just said, must be considered to be nothing more or less than a reserved store of food.

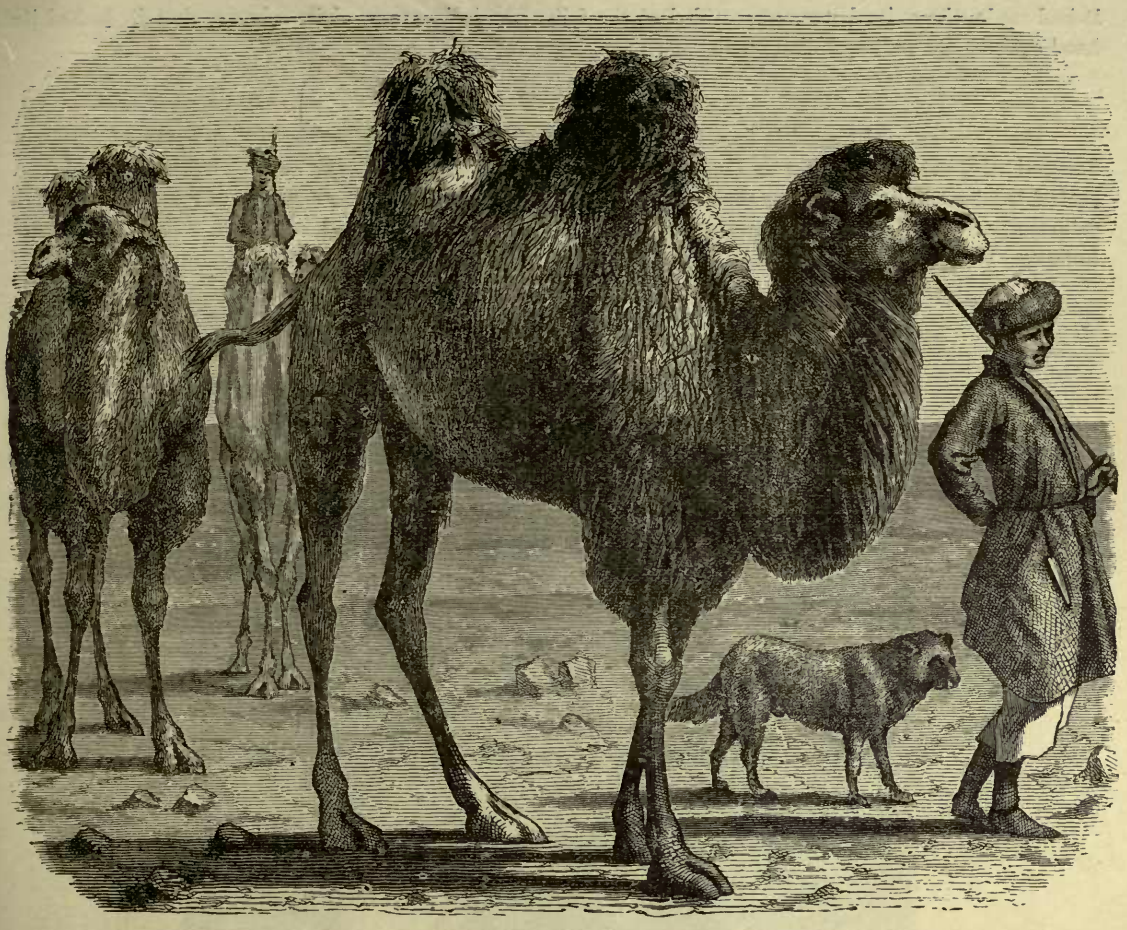
Upon the chest, the elbows, the fore-knees (true wrists), knees, and hocks, callous pads of hardened skin are found, upon which the creature supports its weight whilst kneeling down, a position in which it always rests, and one which it assumes when being loaded. These pads are present in the new-born Camel-calf, proving, contrary to the view maintained by some, that they are not the direct result of pressure, but are special provisions in accordance with the requirements of the species, arrived at by a process of natural selection, those individuals alone surviving in which there is the power of resisting the injurious effects of protracted strain upon a few spots of the skin.

The coat is, in the summer, scanty; in the winter, of considerable length, and matted into lumps. The two-toed feet are very much expanded, and tipped with a pair of small hoofs. The lips are covered with hair, the upper one being split up for some distance in the middle line. The nostrils, when closed, are linear, and from their construction prevent sand from entering the air-passages when the animal desires it. The tail is of fair length, reaching to the ankle-joint. There is a fixity about its attitudes, and a formality about its paces, which is quite characteristic. Its power of enduring fatigue upon its scanty fare, whilst carrying a weight as great as 600 lbs., together with its endurance, makes it invaluable in its desert home.

A stolid obstinacy is its usual disposition. Mr. Palgrave, criticising the reputation that the animal has for docility, remarks :—"If docile means stupid, well and good; in such a case the Camel is the very model of docility. But if the epithet is intended to designate an animal that takes an interest in its rider so far as a beast can; that in some way understands his intentions, or shares them in a subordinate fashion; that obeys from a sort of submissive or half fellow-feeling with his master,



(TRUE) CAMEL.



BACTRIAN CAMEL.

like the Horse or Elephant: then I say that the Camel is by no means docile—very much the contrary. He takes no heed of his rider, pays no attention whether he be on his back or not, walks straight on when once set agoing, merely because he is too stupid to turn aside; and then, should some tempting thorn or green branch allure him out of the path, continues to walk on in the new direction simply because he is too dull to turn back into the right road. In a word, he is from first to last an undomesticated and savage animal rendered serviceable by stupidity alone, without much skill on his master's part, and any co-operation on his own, save that of an extreme passiveness. Neither attachment nor even habit impresses him; never tame, though not wide awake enough to be exactly wild."

Nevertheless the animal gives indications of intelligence when badly treated, if we may judge from its revengeful nature, well illustrated in the following account:—

"A valuable Camel, working in an oil-mill, was severely beaten by its driver. Perceiving that the Camel had treasured up the injury, and was only waiting a favourable opportunity for revenge, he kept a strict watch upon the animal. Time passed away; the Camel, perceiving that it was watched, was quiet and obedient, and the driver began to think that the beating was forgotten, when one night, after the lapse of several months, the man was sleeping on a raised platform in the mill, whilst, as is customary, the Camel was stabled in a corner. Happening to awake, the driver observed by the bright moonlight that, when all was quiet, the animal looked cautiously around, rose softly, and stealing towards a spot where a bundle of clothes and a bernous, thrown carelessly on the ground, resembled a sleeping figure, cast itself with violence upon them, rolling with all its weight, and tearing them most viciously with its teeth. Satisfied that its revenge was complete, the Camel was returning to its corner, when the driver sat up and spoke. At the sound of his voice, and perceiving the mistake

it had made, the animal was so mortified at the failure and discovery of its scheme, that it dashed its head against the wall and died on the spot."

THE BACTRIAN CAMEL.*

The Two-humped Camel is found in the regions to the east and north of the home of its One-humped ally, extending as far as Pekin and Lake Baikal. It it a heavier, shorter-legged, and thicker-coated species, at the same time that the feet are more adapted to a less yielding soil from their greater callousness. The hair is specially abundant upon the top of the head, the arm, wrist, throat, and humps. There is no variety of this species corresponding to the Dromedary One-humped Camel.

HUANACO ATTACKED BY A PUMA.

THE LLAMAS.†

The Llamas, when the term is employed in its wider sense, include the American representatives of the Camel tribe, none of which have any trace of the dorsal hump or humps found in their Old World allies. They are mountain animals, found in the Cordilleras of Peru and Chili, in this respect also differing from the desert-loving Camels, with which they agree in all important structural peculiarities, including the stomach, lips, nostrils, and coat. The feet are somewhat modified in accordance with the rocky nature of the mountain regions which they inhabit, the sole-pads being less considerable, and almost completely divided into two hard cushions, with a long and hooked nail in the front of each.

Llamas were found domesticated when South America was first discovered by the Spaniards,

* *Camelus bactrianus.* † *Auchenia.*

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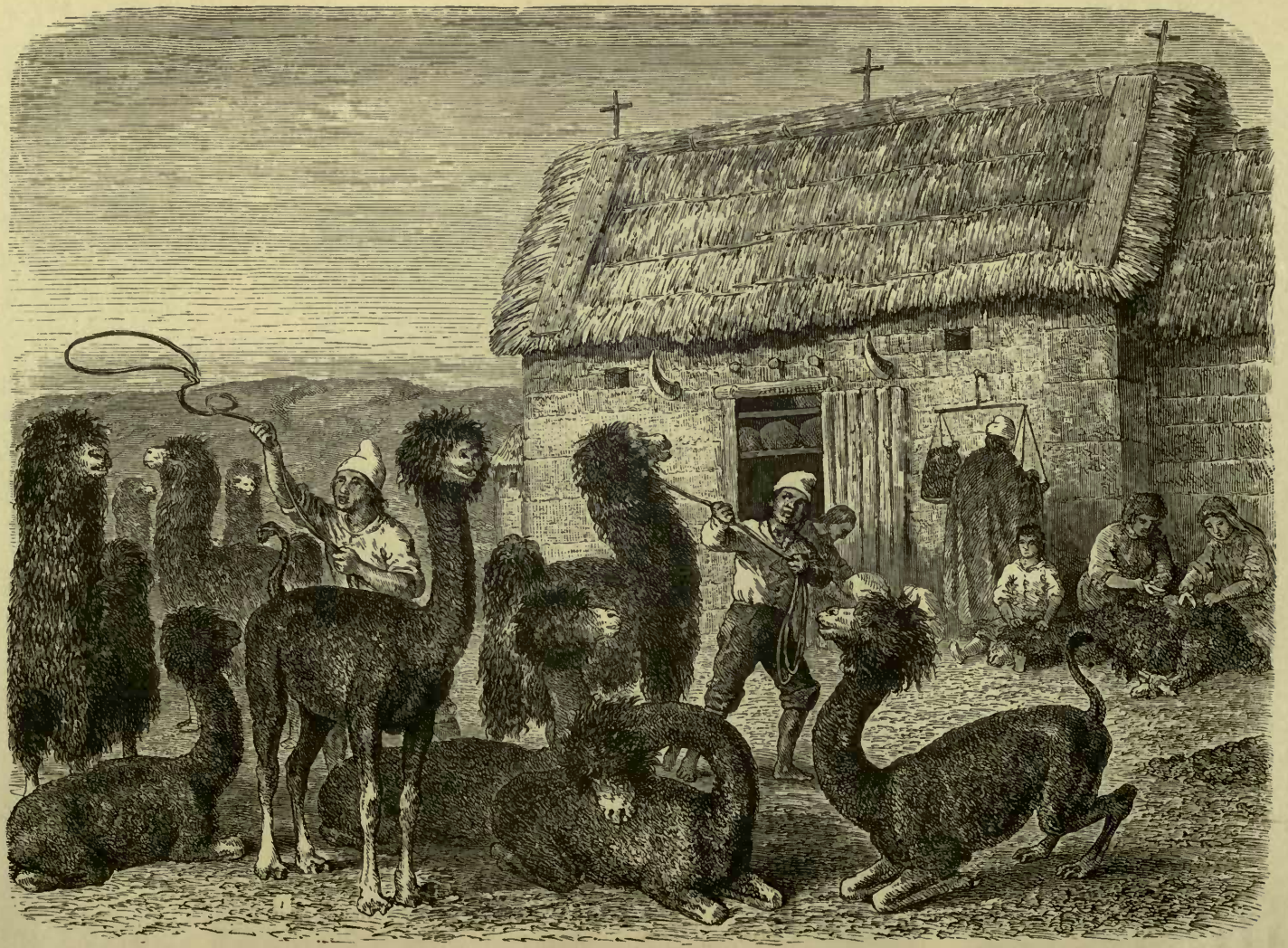


and as there were then no Mules or Horses there, these creatures were employed exclusively as beasts of burden, as well as for their flesh, their wool, and hides. Their disposition and their habits also resemble those of the Camel. They have their own peculiar gait and speed, from which they cannot well be made to vary. When irritated they foam at the mouth and spit, sulking and lying down when overloaded. As beasts of draught their most important use is to convey the ores from the mines of Potosi and elsewhere in the Andean range. From the account of Augustin de Zerate, who was a Peruvian Spanish Government official in the middle of the sixteenth century, we learn that "in places where there is no snow the natives want water, and to supply this deficiency they fill the skins of Sheep [Llamas being meant] with water, and make other living *Sheep* carry them, for it must be remarked that these *Sheep* of Peru are large enough to serve as beasts of burden. They can carry about one hundred pounds or more, and the Spaniards used to ride them, and they would go four

LLAMA.

or five leagues a day. When they are weary they lie down upon the ground, and as there is no means of making them get up, either by beating or assailing them, the load must of necessity be taken off. When there is a man on one of them, if the beast is tired he turns his head round and discharges his saliva, which has an offensive odour, into the rider's face. These animals are of great use and service to their masters, for their wool is very good and fine, particularly that of the breed called Pacas, which have very long fleeces; and the expense of their food is trifling, as a handful of maize suffices them, and they can go four or five days without water. Their flesh is as good as that of the fat Sheep of Castile."

It is somewhat difficult to decide exactly the relations of the wild to the domesticated species of the Llamas. It seems most probable that there are two true species, known as the Huanacos (*Lama huanacos*) and the Vicuna (*Lama vicugna*), of the former of which the true Llama is a domesticated variety, as the Alpaca is of the latter.

The HUANACO—or Guanaco, as it is sometimes written—has a more elongated head and more slender legs than the Vicuna, at the same time that there are elongated warty tubercles upon the hinder limbs not found in the latter species. Its height at the shoulder is three feet and a half. The fur is uniformly brown, at the same time that it is rough and short. It can be domesticated without difficulty. Its tail is short and hairy. Its native haunts are the highlands of Peru and Chili, as well as farther south, where it lives in herds, which descend to the valleys in the winter

months. When hunted they have a habit of now and again facing their pursuers, after which they gallop off afresh. When attacked at close quarters they defend themselves by striking with their fore-feet. From Mr. Darwin's account of the animal in the "Voyage of the *Beagle*," we learn that it "abounds over the whole of the temperate parts of South America, from the wooded islands of Tierra del Fuego, the rough Patagonia, the hilly parts of the La Plata, Chili, even to the Cordillera of Peru. Although preferring an elevated site, it yields in this respect to its near relative the Vicuna; on the plains of Southern Patagonia we saw them in greater numbers than in any other part. Generally they go in small herds, from half a dozen to thirty together, but on the banks of the St. Cruz we saw one herd which must have contained at least five hundred. On the northern shores of the Strait of Magellan they are also very numerous. Generally the Guanacoes are wild and extremely wary. The sportsman frequently receives the first intimation of their presence by hearing from a distance the peculiar shrill neighing note of alarm. If he then looks attentively, he will perhaps see the herd standing in a line on some distant hill. On approaching them, a few more squeals are given, and then off they set at an apparently slow—but really quick—canter along some narrow beaten track to a neighbouring hill. If, however, by chance he should abruptly meet a single animal, or several together, they will generally stand motionless, and intently gaze at him; then, perhaps, move on a few yards, turn round, and look again. What is the cause of this difference in their shyness? Do they mistake a man in the distance for their chief enemy, the Puma, or does curiosity overcome their timidity? That they are curious is certain; for if a person lies on the ground and plays strange antics, such as throwing up his feet in the air, they will almost always approach by degrees to reconnoitre him. . . . On the mountains of Tierra del Fuego, and in other places, I have more than once seen a Guanaco, on being approached, not only neigh and squeal, but prance and leap about in the most ridiculous manner, apparently in defiance as a challenge. . . . The Guanacoes readily take to the water; several times at Port Valdez they were seen swimming from island to island. Byron, in his 'Voyage,' says he saw them drinking salt water. Some of our officers likewise saw a herd drinking the briny fluid from Salina, near Cape Blanca. I imagine, in several parts of the country, if they do not drink salt water they drink none at all. In the middle of the day they frequently roll in the dust in saucer-shaped hollows. . . . The Guanacoes appear to have favourite spots for dying in. On the banks of the St. Cruz the ground was actually white with bones in certain circumscribed places, which were generally bushy, and all near the river. On one such spot I counted between ten and twenty heads, some gnawed, as if by beasts of prey."

The Domestic Llama resembles its wild ancestor in most respects. Its colour may, however, be variegated, or even white. Its woolly coat is longer, but not so fine, and when it is removed by shearing the animal is conspicuously spotted.

The VICUNA is a smaller animal of a light lion-brown colour, with a short and hairy face; its neck is lengthy, as in its allies; its height about two feet six inches. Its wool is particularly fine, and has been much employed, undyed, as a material for clothing. It is active and spiteful, inhabiting a region higher and therefore colder than the Huanaco.

The Alpaca is its domestic form, with thicker and much darker wool, as well as shorter limbs. Its colour is often nearly black, or black varied with white or brown.

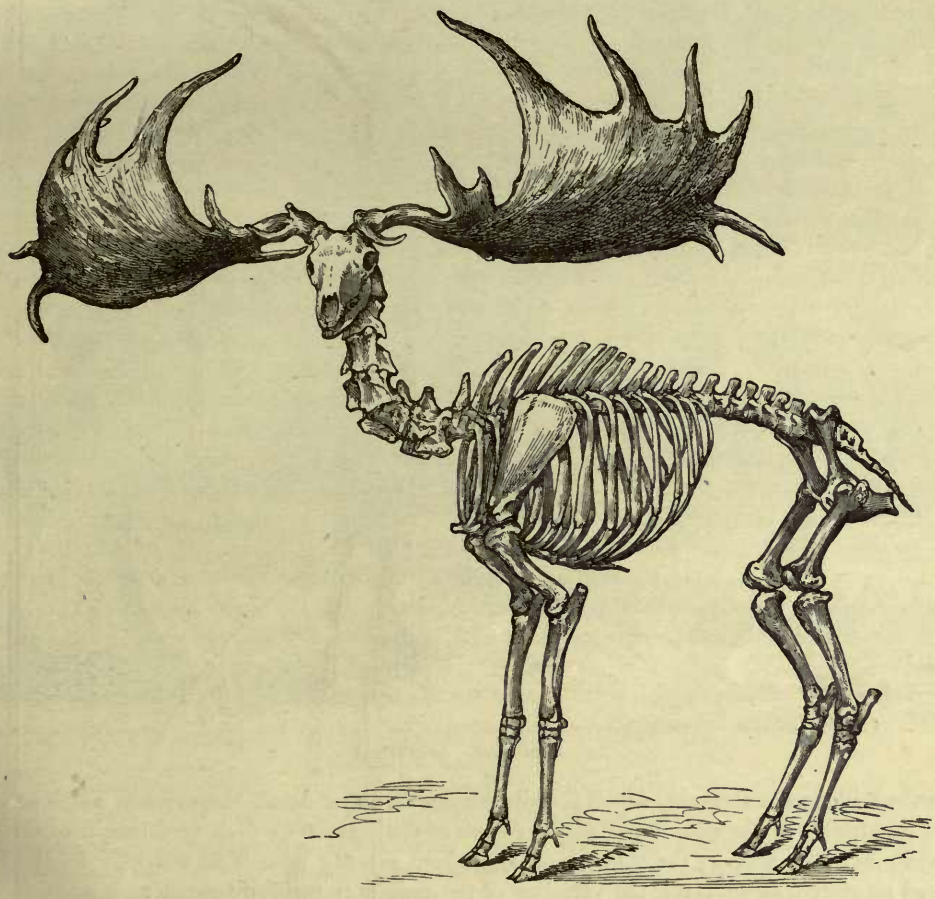
The manufacture of alpaca stuffs dates from the year 1836, when Mr. (afterwards Sir) Titus Salt commenced weaving the unusually long-haired wool, which at the time found no sale in the markets on account of its not being suited to the existing combing apparatus. Since that period alpaca has been much employed as a fabric, possibly to be again replaced in great measure by the sheep wool of the Australian and other British colonies.

FOSSIL RUMINANTIA.

The study of fossil forms throws as much light upon the development of existing types of Ruminantia as it does in the case of the Perissodactyla. Until the last of the three great geologic epochs none have been found; whilst in the Tertiary strata from Eocene, Miocene, and Pliocene formations, numerous species are known, resembling existing types more closely as they are discovered in the more recently deposited strata.

As might be anticipated from what has been said above, and as is indicated in the table of classification of the Artiodactyla on page 336, Vol. II., the oldest forms of cloven-hoofed Mammalia must have been intermediate in structure between the Pigs and Ruminants. Such a creature existed at the close of the Eocene period in *Chœropotamus*, discovered first by the illustrious Cuvier in the palæontologically most interesting gypsum beds at Montmartre. Another specimen has also been found near Ryde, in the Isle of Wight. The creature was pig-like in size, and in the tuberculated structure of its grinders, the parts, together with the lower jaw, alone discovered as yet.

Hyopotamus, *Dichobune*, *Xiphodon*, and *Cainotherium* were four-toed Upper Eocene transitional



SKELETON OF THE IRISH ELK.

forms approaching the Ruminants, but all possessing upper cutting-teeth, the last-named differing but little from the Deerlets. *Oreodon* is a genus of small pig-like animals, appearing first in the Miocene of North America, and evidently closely related to the Ruminantia. *Sivatherium* was a gigantic Ruminant with four horns in pairs, and evidently a trunk. Its remains are found in the Miocene deposits of the Sewalik hills of India. Deer, Oxen, Goats, and Sheep first appeared in the Pliocene period, as did Camels and Llamas. Antelopes and Giraffes existed earlier, namely, in the Late Miocene. It is a fact of interest that Camels are abundant in the Miocene and Pliocene of North America, whilst they are only very scantily distributed in the same strata of the Old World, Arabia and Asia being their sole living habitat.

Among the most interesting of the Pleistocene species which has been discovered in Great Britain is the gigantic Irish deer, a species originally included with the Elk, on account of the palmation and outward inclination of its huge antlers, in some specimens only a few inches less than

eleven feet in span, and each more than five feet long in a straight line from burr to tip. In general form the antlers do not strikingly differ from those of the Common Fallow Deer. The brow-tyne is quite simple at its base, and generally slightly bifid at its extremity, there being no true "bez." The beam is cylindroid as far as the insignificant "trez," beyond which it is flattened out into a gigantic triangular expansion, or "palm," with the free base developed into snags, usually about seven in number, and a fairly independent posterior tyne.

IRISH ELK. (*Restored.*)

At the withers the skeleton, which is quite cervine in every detail, measures as much as six feet; its great peculiarity in the male being the large size of the cervical or neck vertebræ, necessarily extra strong that they may support the massive antlers, about seventy pounds in weight. In the females, which had no cranial appendages, the vertebræ of the neck were one-third smaller.

The accompanying figure is an attempt to represent the species under consideration, as it must have appeared when living. It is worthy of note, however, that as the coat of the Fallow Deer, which may be its nearest ally, is brilliantly spotted, the great Irish Deer may have resembled it in that respect.

The first fairly complete skeleton of the species was found in the Isle of Man. Others have been obtained from Waterford and elsewhere in Ireland.

A. H. Garrod.

PRAIRIE DOG.

ORDER RODENTIA.

CHAPTER I.

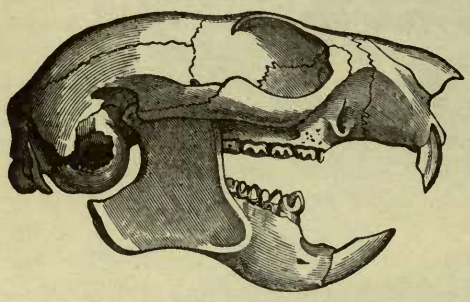
INTRODUCTION—THE SQUIRREL, MARMOT, ANOMALURE, HAPLODONT, AND BEAVER FAMILIES.

Character of the Order—A well-defined Group—Teeth Evidence—Kinds and Number of Teeth—The Incisors: their Growth, Renewal, and Composition—The Molars—The Gnawing Process—Skeleton—Brain—Senses—Body—Insectivora and Rodentia—Food of Rodents—Classification—THE SIMPLE-TOOTHED RODENTS—Characteristics—THE SQUIRREL-LIKE RODENTS—SCIURIDÆ—Distinctive Features—THE COMMON SQUIRREL—Form—Distribution—Food—Bad Qualities—Habits—THE GREY SQUIRREL—THE FOX SQUIRREL—Flying Squirrels—Their Parachute Membrane—THE TAGUAN—Appearance—Habits—Other Species—THE POLATOUCHE—THE ASSAPAN—The Genus *Xerus*—THE GROUND SQUIRRELS—THE COMMON CHIPMUNK—THE MARMOTS—Distinguishing Features—THE SPERMOPHILES—THE GOPHER—THE SISEL, OR SUSLIK—THE BARKING SQUIRRELS—THE PRAIRIE DOG—Description—Species—Habits—Burrows—Fellow-inmates in their "Villages"—THE TRUE MARMOTS—THE BOBAC—THE ALPINE MARMOT—THE WOODCHUCK—THE HOARY MARMOT, OR WHISTLER—ANOMALURIDÆ—Tail Peculiarity—Distinctive Features—HAPLODONTIDÆ—Description—THE SEWELLEL—CASTORIDÆ—THE BEAVER—Skeletal Peculiarities—General Form—Appearance—Distribution—The Beavers of the Old and New World—Habits—Wonderful Sagacity—The Building Instinct—Their Method of Working—The various Stages—Their Lodges—Their Dams—Activity by Night—Flesh—Hunted—The *Castoreum*.

WHILE the last few chapters have been devoted to orders which contain the largest and most powerful of terrestrial mammalia, we have now to treat of a group, all the members of which are of comparatively small size. "Mice, rats, and such small deer," to use Shakspere's phrase, make up a great proportion of the order Rodentia. The biggest of them is only about the size of a small Pig; and perhaps the common House Rat, or, at any rate, the common Squirrel, may be taken as showing the average dimensions of a Rodent. But, although from this point of view they

may be looked upon as "a feeble folk," their numerous species render them a most important section of the mammalian fauna of nearly all countries, and this importance is greatly increased, practically, by the immense number of individuals by which each species is usually represented.

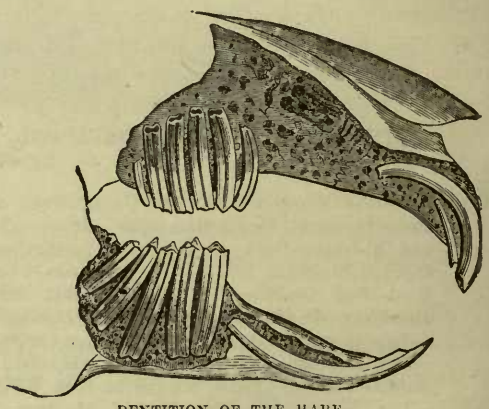
The Rodentia, or gnawing mammals—GLIRES, as Linnæus and some modern zoologists call them—notwithstanding the great number of the species and the immense variety of forms which they display, constitute, perhaps, the most definitely circumscribed order of the Mammalia. In most other groups of the same value, we find that some types exhibit divergent characters, which render it difficult to frame a general description of the order which shall include them; or else some species present a marked tendency towards some other order; but in the case of the Rodents, we never have any difficulty, a cursory inspection of the dentition is always sufficient to decide whether a quadruped belongs to the Rodentia or not; and in spite of an almost infinite variety of form, the structure of the rest of the organism is most clearly in accordance with the evidence derived from the teeth.



SKULL OF THE TAGUAN, A FLYING SQUIRREL.

The teeth are only of two kinds—incisors and grinders (*see* the above figure of the skull of the Taguan)—and the number of efficient teeth of the former kind is never more than two in each jaw. Almost throughout the order, indeed, there are actually, even from the first, only two incisors present; but in the Hares and Rabbits, and some allied forms, there are in the upper jaw, in addition to the working teeth, a pair of rudimentary incisors,* placed immediately behind the large ones, but quite incapable of taking any part in the business of gnawing, for which the latter are so admirably fitted. Their presence is, however, of interest, as indicating the direction in which an alliance with other forms of Mammalia more abundantly supplied with teeth is to be sought.

The great incisors, which are characteristic of the Rodents, exhibit the following peculiarities:—They possess no roots, but spring from a permanent pulp, so that they continue growing during the whole life of the animal; and their form, and that of the cavity which constitutes their socket, is always that of a segment of a circle,† in consequence of which, they always protrude from the front of the jaws in the same direction, and meet at the same angle. By this means, as the teeth are worn away at their summits by use in gnawing, a fresh supply of tooth is continually being pushed forward to take the place of the portion thus removed, and, in fact, so intimately are the two functions of use and growth correlated in the teeth of these animals, that if by chance one of the incisors should get broken, or the natural opposition of these teeth should be disturbed in consequence of injury to the jaw, the teeth, thus deprived of their natural check, continue growing, and, following the curve of their sockets, gradually form circular tusks, which must always be greatly in the way of the animal when feeding, and sometimes, by actually penetrating again into the mouth, cause its death by absolute starvation. The teeth themselves are composed of dentine, coated along the front surface with a layer of hard enamel, which substance is wanting on the other surfaces of the teeth, except in the Hares, Rabbits, and other forms with additional rudimentary incisors in the upper jaw, in which, as further evidence of their relationship to the other Mammalia, the whole surface of the incisors is encased in enamel, although this coat is excessively thin except on the front or outer face. The purpose



DENTITION OF THE HARE.

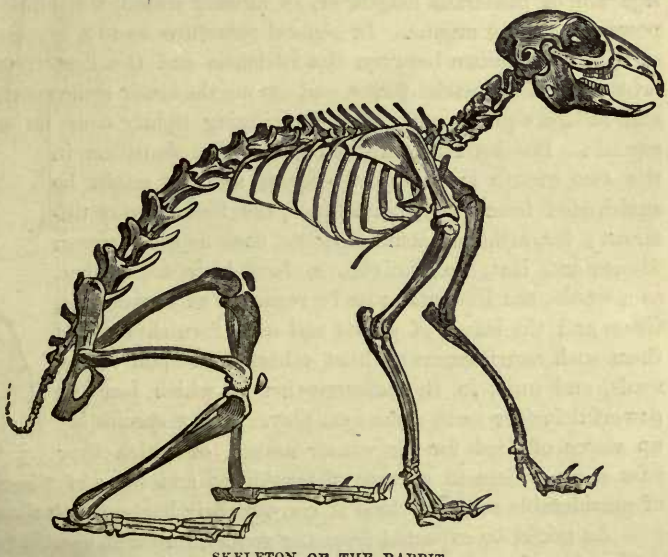
* In the young there are four of these small additional teeth, but the outer pair disappear after a short time.

† The upper teeth always constitute a larger segment of a smaller circle than the lower ones.

of this structure of the incisors is easily understood. In the action of gnawing, the dentine, which forms the greater part of the tooth, is more easily abraded than the harder enamel, which is thus left as a sharp front edge, to which the mass of dentine behind it, being worn away into a bevelled surface, gives the necessary firmness and support, the whole forming a chisel-like instrument, constructed precisely on the principle of those tools in which a thin plate of hard steel forms the cutting edge, and is stiffened by a thicker bevelled plate of softer iron.

The canine teeth are entirely deficient, and behind the incisors we find on each side a toothless gap of considerable extent (*see* figures p. 82), beyond which come the grinding teeth. In these it is difficult to recognise any distinction of molars and pre-molars; the whole series presents nearly the same structural characters, and for all practical purposes we may speak of them as molars, although some zoologists prefer to regard the three hindmost teeth on each side as true molars, and any others that may be present as premolars. In one genus (*Hydromys*) the number of grinding teeth is reduced to two on each side in each jaw; in a great proportion of the species the number is three; others have four or five grinders on each side, either in one or both jaws (usually one more in the upper series); and the largest number is possessed by the Hares and Rabbits, in which the upper jaw has six and the lower five grinders.* The grinders are sometimes furnished with true roots, but are more commonly open below, and provided, like the incisors, with a permanent pulp. They are sometimes tubercular, at least in youth, but generally show a flat, worn surface with transverse bands, or re-entering folds, and sometimes cylinders of enamel, which display a great variety of patterns. Sometimes the enamel is confined to the surface of the tooth; in other cases each tooth is, as it were, made up of two or more variously-shaped tubular portions of enamel, filled up with dentine. Curiously enough, this structure of the grinders, especially the arrangement of the transverse ridges and plates of enamel in these little animals, reminds us strongly of the characters of the molars of the gigantic Proboscidea, in which, moreover, the incisors also are represented by the permanently-growing tusks.

The articulation of the lower jaw with the skull is peculiar, and in special relation to the armature of teeth which we have described. Instead of articulating freely, as in man and many herbivorous mammals, by which provision is made for a sort of rotatory action of the molars, or by a regular transverse hinge-joint, as in the Carnivora, the articulating surfaces are elongated in a direction parallel to the middle line of the skull, an arrangement which, like that occurring in Carnivora, has the effect of preventing much lateral movement of the jaw; but, at the same time, the pits with which the jaw articulates are open in front, so that the jaw is allowed a certain amount of play, backwards and forwards. This motion greatly increases the gnawing power of the large incisor teeth.



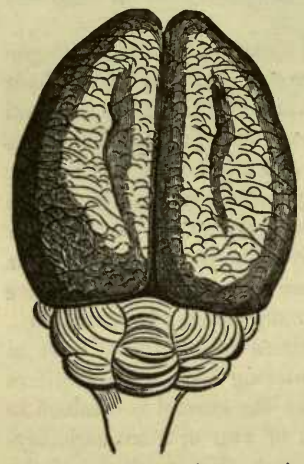
SKELETON OF THE RABBIT.

The head in the Rodents is generally of small or moderate size in proportion to the body, and the skull is usually rather elongated, and flattened on the upper surface. The tympanic bullæ are generally of considerable size; the zygomatic arch is in nearly all cases well developed; but the orbits of the eyes are never closed behind, and only in certain families is there even a small process of the zygomatic arch behind the orbits, as an indication of possible closure. Of the vertebral column we need only say that the lumbar vertebræ are remarkable for possessing large transverse processes directed forwards, and that the tail varies

* The genus *Heliophobius* among the Mole Rats is described as having six molars on each side in both jaws; but the number in this genus appears to be variable, the sixth molar being often undeveloped.

greatly in length, being sometimes longer than the body, sometimes reduced to very small proportions, whilst between these two extremes almost every grade of development may be met with.

The sternum, or breast-bone, is usually long and narrow. Collar-bones are nearly always present, but in a few forms they become rudimentary, or even disappear altogether. The pelvis is long and narrow. The limbs exhibit a very great variety in their development; in many, the two pairs are nearly equal in length, but in the majority the hind limbs are distinctly longer and more powerful than their fellows, and in some groups they attain a most disproportionate length, and serve almost exclusively as the organs of locomotion. On the other hand, in the great majority of the order, the fore limbs serve in a certain degree as hands, and are used for holding the food to the mouth; and in these the radius and ulna, which are always distinct bones, retain the power of rotation. The corresponding bones in the hind limbs (tibia and fibula) are, on the contrary, firmly anchylosed together in two great groups of the order. The feet have usually five toes, but sometimes this number is reduced to four, or even to three, in the hind feet. These toes are armed with claws, which, however, in one family, acquire more or less of the appearance of hoofs.



BRAIN OF BEAVER (*from above*).

In point of intelligence the Rodentia do not stand high. The brain is comparatively small, and the cerebral hemispheres show no traces of those convolutions of the surface which are characteristic of most Mammals (*see* figures). The Capybara alone is known to have a few convolutions. The cerebellum is entirely uncovered by the hemispheres. The organs of the senses are generally well developed, and the eyes and external ears, especially, are often of large size. In the Mole Rats and some other burrowing forms, however, the external ears are entirely wanting, and the eyes are very much reduced in size, and in some instances even concealed beneath the skin. The intestinal canal is long, and in all but one family furnished with a distinct cæcum.

The body in the Rodents is generally plump and short, and the head is borne upon a short neck. The limbs also are usually short, so that the belly is close to the ground; but in some cases all four legs are of moderate length, or, as already stated, the hind legs are enormously developed, forming powerful leaping organs. In general structure, as to a certain extent in habits, there is, in fact, a most striking parallelism between the Rodentia and the Insectivora (*see* Vol. I., p. 343); in both we find arboreal and terrestrial forms, and among the latter some specially organised for burrowing in the earth, and others equally adapted for springing lightly over its surface; a few, also, in both orders, are aquatic. But here the parallel ceases. The dentition in the two groups is widely divergent, and, as might be anticipated from this circumstance, the food is very different; for, although some Rodents, such as the common Mouse and Rat, are omnivorous, there is no doubt that, as a whole, the Rodents must be regarded as vegetarians. Grass and the leaves of plants and trees furnish some of them with nourishment; whilst others feed upon fruits, seeds, and nuts, in the consumption of which last the powerful incisor teeth come into play. Many species lay up stores of food for the winter season, of which they pass more or less in a state of torpidity; and some of these are provided with cheek-pouches, often of considerable size, in which to convey their harvest into their store-houses.

BRAIN OF BEAVER. (*Profile.*)

As might be expected from the great number of species belonging to this order, and their general uniformity of structure, their classification is a matter of some difficulty, and very different views as to their relationships have prevailed at different times. Nowadays, however, zoologists have arrived at something like uniformity of opinion in this matter, and except in some minor points they may be said to be pretty nearly agreed. In the following sketch of the natural history of the Rodents we shall follow the classification proposed by the late Mr. E. R. Alston in the *Proceedings of the Zoological Society*. Mr. Alston accepted the division of the order into two primary groups (sub-orders),

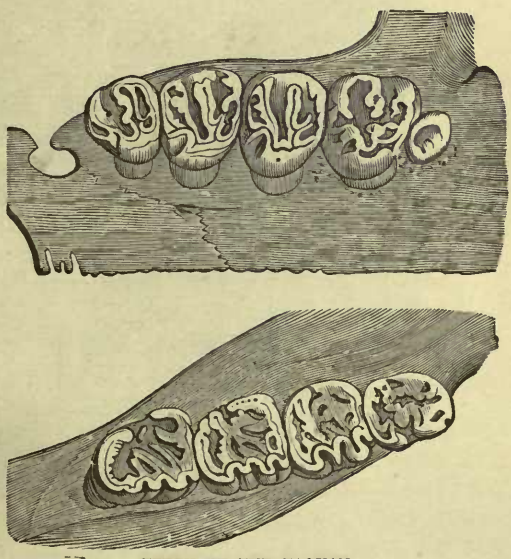
proposed fifty years ago by Professor Gervais, and characterised by the number of incisor teeth. The first of these sub-orders, which includes by far the majority of the Rodents, is formed by those species which never at any period of their lives possess more than two incisors in the upper jaw, and have the enamel on these strictly confined to the front surface of the teeth. These are denominated SIMPLICIDENTATA, or SIMPLE-TOOTHED RODENTS. In the second group, which includes only the Hares, Rabbits, and Calling Hares, we have those species which in the adult state possess four incisors in the upper jaw, namely, two large and efficient teeth, and behind these two small, almost rudimentary incisors (*see* figure of the dentition of the Hare on p. 82). These are called DOUBLE-TOOTHED RODENTS, or DUPLICIDENTATA.

SUB-ORDER I.—SIMPLE-TOOTHED RODENTS.

Besides the characters derived from the number of incisor teeth above mentioned, several other peculiarities of structure seem to show the existence of a decided difference between the Simple-toothed and Double-toothed Rodents; but most of these are of a rather abstruse nature, and need not be noticed here, the most important additional distinctive characters of the former being that the bony palate is well developed, and that the fibula does not articulate with the calcaneum, or heel-bone; whereas in the Double-toothed Rodents the palate is reduced to a mere bridge between the portions of the upper jaw in which the teeth are inserted, and the fibula does articulate with the heel-bone.

The Simplicidentata include a great number of families, and various attempts have been made to group these under larger heads; but it must be confessed that, owing to the way in which the families approach one another, it is difficult to bring them together in sections capable of being very strictly defined. Certain broad principles of relationship are, however, generally recognised, and Mr. Alston represented these by placing the Simple-toothed families under three great sections, the first indicated by Mr. Waterhouse—the Squirrel-like, Mouse-like, and Porcupine-like Rodents.

The Squirrel-like Rodents have four molars on each side in the lower jaw, and either four or five in the upper. When the latter number is present, the foremost tooth is smaller than the rest. The fibula remains as a distinct bone through life, and is usually quite free, although sometimes attached to the tibia at the extremity. The upper lip is usually cleft, the muffle is small and naked, and the nostrils are comma-shaped, with the rounded part above. The zygomatic arch is formed chiefly by the process of the malar bone, which is not supported below by a continuation of the zygomatic process of the maxillary. The collar-bones are perfect. The tail is usually cylindrical and hairy.



TEETH OF THE TAGUAN.

The Mouse-like Rodents agree with the preceding in the characters of the upper lip, muffle, and nostrils, but they have the tibia and fibula completely united for at least the last third of their length. The zygomatic arch is slender, and the malar process rarely extends so far forward as in the preceding group, and is generally supported below by a continuation of the maxillary process. The collar-bones are perfect, except in one very small family; and the tail is cylindrical, and although sometimes hairy, more commonly covered with scales arranged in rings. The number of molar teeth in this section varies from three to six * on each side in each jaw, but three is the most usual number.

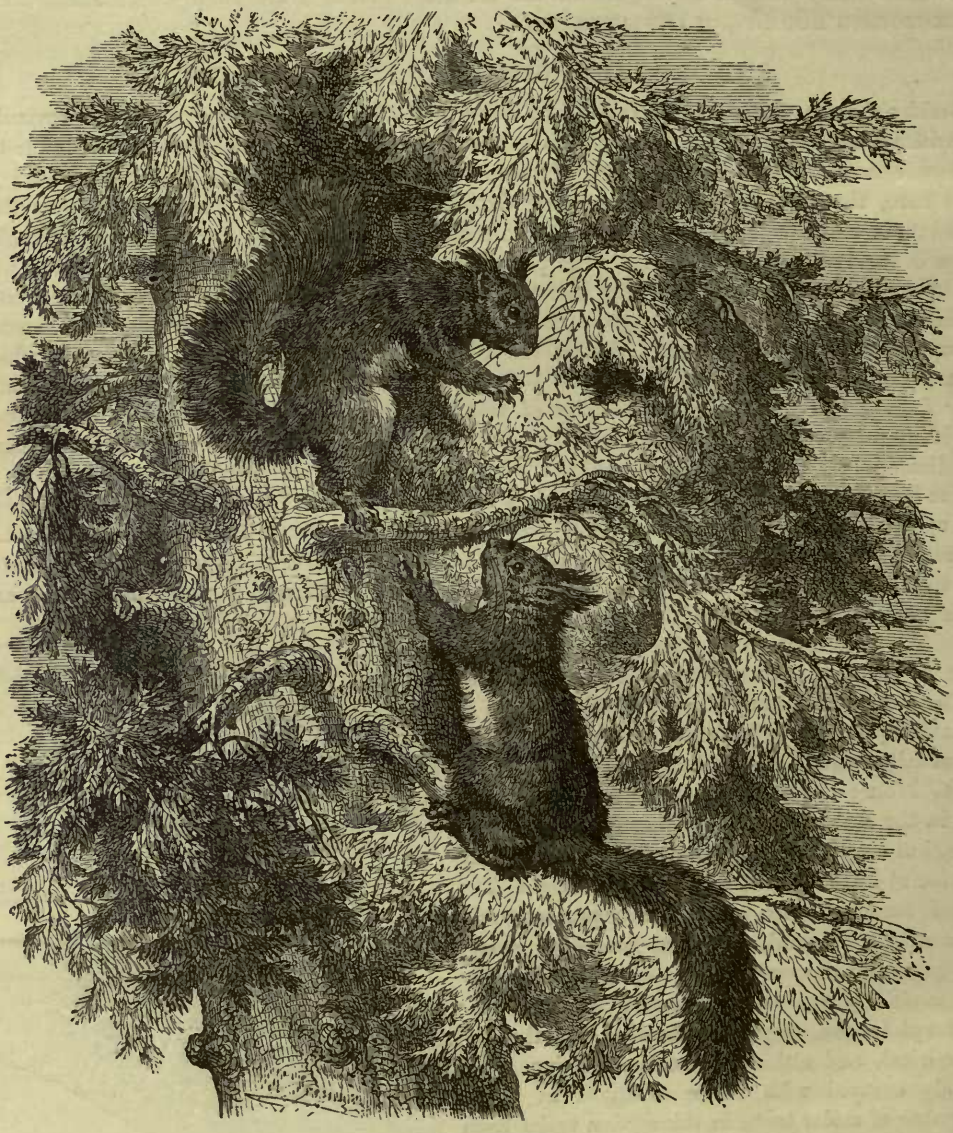
The Porcupine-like Rodents, with one exception, have four molars on each side in both jaws; the fibula distinct throughout life; the upper lip rarely cleft; the muffle clad with a velvety coat of fine hairs; and the nostrils either S-shaped or straight. The zygomatic arch is stout, and the malar process does not advance far forward, nor is it supported below by the maxillary process.

* See Note on p. 83.

SECTION I.—(*SCIUROMORPHA.*) SQUIRREL-LIKE RODENTS.

FAMILY I.—SCIURIDÆ.

This first family, which includes the true Squirrels and the Marmots, is distinguished from the rest of the section by the possession of five rooted molars on each side of the upper jaw (*see* figure of



COMMON SQUIRREL.

the teeth on p. 85), the first being very small and sometimes deciduous, and four molars on each side of the lower jaw, and by the presence on the skull and zygomatic arch of small processes, indicating the posterior boundary of the orbits (*see* figure of the skull on p. 82). The molars are tubercular, at least at first; but the summits of the tubercles are generally more or less worn down as the animal increases in age.

The true Squirrels, which may be regarded as the types of this family, are distinguished by their slender and graceful forms, and their long and generally bushy tails, the latter character having originated their classical name of *Sciurus*, as a compound of two Greek words, indicating their habit of carrying their tails thrown up, so as to shade the back. Our COMMON SQUIRREL (*Sciurus vulgaris*) may serve as a good example of this division of the family. It is too well known as a pet to need any detailed description; its elegant form and graceful movements, the rich brownish-red colour of its upper surface, contrasting with the white of the belly, and the beautifully-pencilled or tufted ears, which, combined with its bright black eye, give it such a lively appearance, must be familiar to every one. When full-grown, the Squirrel measures from eight to ten inches in length of body, and has a tail seven or eight inches long. British specimens are generally smaller than those from the Continent of Europe. It varies considerably in colour with the seasons, especially in northern regions; but even in Central Europe and in Britain the fur of the sides and back becomes mixed with a certain quantity of greyish-white hairs in the winter, whilst in Lapland and Siberia the whole upper surface acquires a grey tint at that season. In the summer also the ear-tufts diminish, or altogether disappear. In the Alps and Pyrenees, there is a variety having the back of a dark brown colour, speckled with yellowish-white. This has been described as a distinct species, under the name of *Sciurus alpinus*.

The Common Squirrel is a widely-distributed species. It is abundant all over Europe, except, according to Pallas, in the Crimea, and extends beyond the Ural Mountains through the whole length of Southern Siberia to the Altai and the Amoor region. It occurs in the Caucasus, and probably in Persia. Everywhere it haunts the woods and forests, living chiefly upon the trees, among the branches of which it displays the most astonishing agility. On the ground—to which, however, it does not often descend—it is equally quick in its movements. If alarmed under these circumstances, it dashes off to the nearest tree with lightning-like rapidity, and by the aid of its sharp claws rushes up the trunk till it has reached what it considers a safe elevation, when the little sharp face and bright eyes may be seen peeping at the intruder, apparently in triumph over his supposed disappointment.

The food of the Squirrel consists chiefly of nuts, beech-mast, acorns, and the young bark, shoots, and buds of trees. In eating the former articles, they are held in the fore-paws, which thus supply the place of hands, and the strong incisors soon make a way through the outer shells into the contained kernels, which alone are eaten; for in all cases in which the kernel is coated with a coarse brown skin (as in the common hazel-nuts), the Squirrel carefully removes every particle of this from the portions on which he feeds. The bark, buds, and young shoots of trees seem generally to be attacked by the Squirrel when he finds a deficiency of other and more congenial nourishment; but this is so regularly the case in the spring of the year, that these animals actually cause a great amount of damage to the trees in forest regions. Hence, not unnaturally, the Squirrel is regarded in forest countries as a most mischievous little animal, whose depredations are not to be condoned on account of its elegant appearance and lively habits. As another unamiable quality, may be mentioned its habit of plundering birds' nests and eating the eggs, which appears to be established upon unquestionable evidence. In some northern regions the inhabitants turn their Squirrels to a more profitable use than putting them, as we so often do, into a sort of treadmill. In Lapland and some parts of Siberia, especially on the banks of the Lena, these animals are killed in great numbers for the sake of their grey winter-coats, which, however, are not equal in beauty to those of the North American Grey Squirrel.

The Squirrel passes the greater part of the winter in a torpid state, lying coiled up in some hole of a tree, where its long bushy tail is of service in keeping it warm and comfortable. On fine and warm days, however, it rouses itself from its slumbers; and, as if foreseeing the occurrence of such days, it lays up in the autumn stores of nuts, acorns, and beech-mast, upon which it can feed when it wakes during the winter. This winter provision is not laid up all in one place, but stored away in several different holes in trees surrounding the place of its own retreat.

Squirrels appear to be strictly monogamous, pairing for life, and constantly inhabiting the same dwelling. The young, three or four in number, are produced in June, and for their reception the parents prepare a very beautifully constructed nest, formed of interlaced moss, leaves, and vegetable fibres, which is placed either in the hole of a tree, or in the fork between two branches. The young

Squirrels are very carefully attended by both parents, and the family remains united until the following spring, when the young go out to find partners, and settle themselves in the world.

The Common Squirrel may serve as an example of the whole genus *Sciurus*, which includes the ordinary Tree Squirrels, the species of which are very numerous, probably more than one hundred, and distributed over nearly all parts of the world. The species are most numerous in the warm Oriental regions, in India, and the countries and islands lying to the east of it, from which nearly fifty species have been recorded. The northern parts of the Old World only possess half a dozen species, but North America has about eighteen, many of which are considerably larger than the European Squirrel. The most striking of the North American species are the GREY SQUIRREL (*Sciurus carolinensis*) and the FOX SQUIRREL (*Sciurus niger*), both of which are abundant in the Atlantic States, and vary considerably in colour, presenting both grey and black individuals.

BLACK FOX SQUIRREL.

Besides the ordinary Squirrels, a considerable number of other species are arboreal in their habits, and, indeed, even more strictly so than the true Squirrels. These are the Flying Squirrels, as they are called, which may be at once distinguished from the others by the presence of a large fold of skin, extending along the sides of the body, and including the limbs as far as the wrists and heels (*see* figure on next page). In the case of the Common Squirrels, it is observed that in performing leaps of any considerable extent the limbs are stretched out, and the long, bushy tail extended, so as to give the animal as large a surface as possible; but in the Flying Squirrels, as in the Flying Lemur (Vol. I., p. 344), when the limbs are extended laterally the folds of skin (*patagia*) become tightly stretched, and form a regular parachute, which seems to give the animal essential support in its most extensive leaps. The extent of this membrane is increased by means of a sort of bony spur, which articulates with the wrist.

The TAGUAN (*Pteromys petaurista*) is a large species, indeed, the largest of the whole family Sciuridæ. It measures about two feet long, and has a bushy tail of nearly equal length. Its ears are pointed, but not tufted, and its eyes are large and prominent. Its colour above is greyish-black, produced by a mixture of entirely black hairs with others having the tips greyish-white; beneath it is greyish-white. About the head and on the limbs the fur is tinged with brown or chestnut brown, and the lateral folds are sometimes of the latter colour, sometimes blackish-brown above and grey beneath. The tail is rounded in its form.

This species inhabits the peninsula of India and Ceylon, Malacca and Siam, where it is found only in the forests, living in trees, either singly or in pairs. Its activity is chiefly nocturnal, in which respect it differs from the ordinary Squirrels. During the day it sleeps in the holes of trees, but at night it comes forth, climbing and leaping with the greatest rapidity about the trees on which it lives. While thus engaged the lateral membranes are loosely folded at the sides of the body; but from time to time the Squirrel wishes to pass from one tree to another at some distance, and then it ascends to a considerable elevation and springs off, at the same time extending all four limbs as much as possible, when the tightly-stretched folds of skin lend the body a support, which enables it to glide through the air to some distance, although it seems always to alight at a lower level than that from

TAGUAN.

which it started. During these aerial excursions the long bushy tail serves as a sort of rudder, and enables the animal even to change its course during flight. Of the habits of the Taguan very little is known. It appears to feed upon fruits, and is exceedingly shy and fearful. Of a nearly-allied species which he observed in China, Mr. Swinhoe says that the nest, which was placed high up in a large tree, measured about three feet in diameter, and was composed of interlaced twigs, and lined with dry grass. It contained only a single young Squirrel; but this might be exceptional.

Some nine or ten additional species of the genus *Pteromys*, which includes the Flying Squirrels with cylindrical tails, are found in the forest regions of India and of the countries to the east of that peninsula, including China, Formosa, and Japan. The same region also harbours three or four species of another kind of Flying Squirrel, in which the long hairs of the tail are arranged in two rows, and the tail is flat instead of cylindrical. These animals, to which the name of *Sciuropterus* has been given, are, however, more numerous in the north, where their distribution extends from Lapland and Finland, through Siberia, to Northern China and Japan. Squirrels of this genus also occur over the whole continent of North America and as far south as Guatemala. The best known of the Old World species is the Polatouche (*Sciuropterus volans*), which inhabits the north-eastern parts of

Europe and nearly the whole of Siberia. It is an elegant little creature, about six inches in length, and with a broad, flat tail, rather shorter than the body: as, indeed, is the case in all the *Sciuropteri*. Its silky coat is in summer of a tawny brown on the upper surface, darker on the flying membrane and the outsides of the limbs, beneath pure white; whilst the tail is greyish above and light rusty red beneath. In winter the fur becomes longer and thicker, and appears of a silver grey colour on the upper surface. The Polatouche lives in the birch woods, or in places where pines, firs, and birches grow intermingled; but the presence of the birch seems to be a necessity of its existence. It is met with singly or in pairs, but always on the trees, sleeping during the day in its nest or in the hole of a tree, and coming forth at dusk to climb and leap about the branches with great agility. In going from tree to tree by the aid of its lateral membranes, it is said to cover distances of twenty or thirty yards with ease, always, however, taking its leap from the highest branches of the tree it starts from, and alighting at a considerably lower level. Its food consists of nuts, seeds, berries, the buds, young shoots, and

POLATOUCHE.

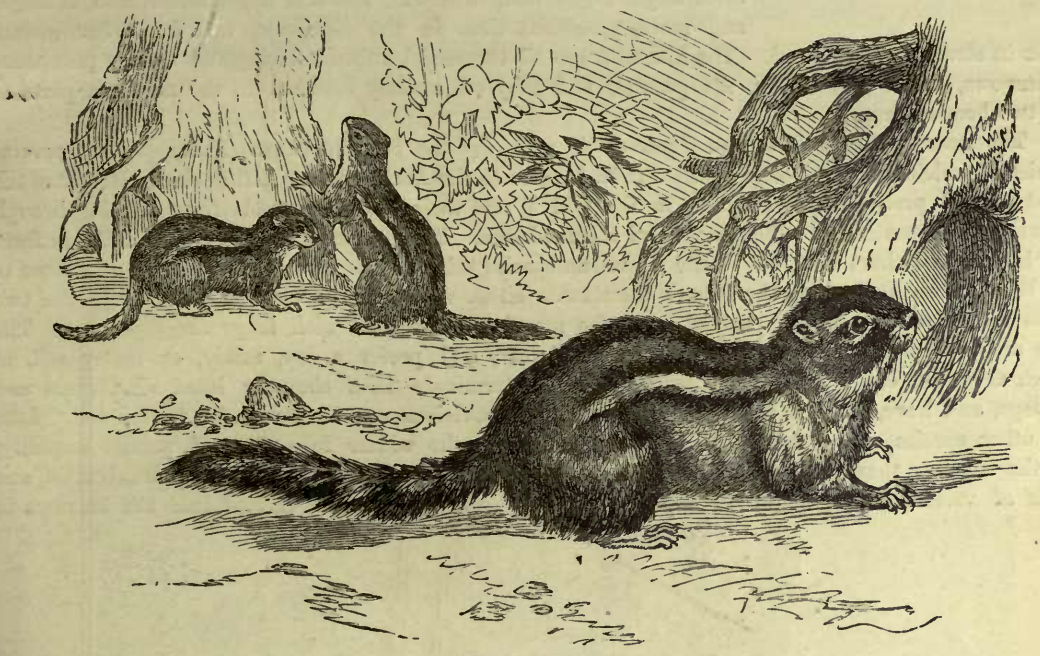
catkins of the birch, and the young shoots of pines and firs. The nest is made in the hole of a tree, carefully lined with soft moss and herbage. Like the Common Squirrel, the Polatouche sleeps through the cold weather, but wakes up from time to time and goes out in search of food.

This group of Flying Squirrels is also represented on the North American continent. The number of species seems rather uncertain, some authors making it two, others four; while Mr. J. A. Allen regards all the North American Flying Squirrels as belonging to a single species, which varies greatly in size in different localities. This species is the Assapan (*Sciuropterus volucella*), one of the smallest of its family, the length of its head and body being only from four and three-quarters to seven and a half inches; the smaller specimens (var. *volucella*) being found in the more southern States, and even as far south as Guatemala; and the larger ones (var. *hudsonius*) in more northern localities. In its habits this elegant little Squirrel resembles the Polatouche, but appears to be more sociable. It thrives well in confinement.

Besides these Tree Squirrels, a few species of the Sciurine sub-family live upon the ground. In Abyssinia and in other parts of Africa some curious animals, forming the genus *Xerus*, are found, distinguished by their very small ears, longish limbs, and the singular texture of their hair, which scantily clothes the skin and generally takes the form of flattened spines. They have a slender body, a pointed head, and a longish tail. These animals live in elevated forest regions, and even upon comparatively barren steppes, where they burrow in the ground under rocks, or among the roots of

trees and bushes. They are diurnal, and feed chiefly upon buds and herbage, but also devour small birds, eggs, and insects. The best known species (*Xerus rutilans*) is about twenty inches long, of which the tail makes about nine inches. Its colour is reddish-yellow above, becoming paler on the sides, and whitish below.

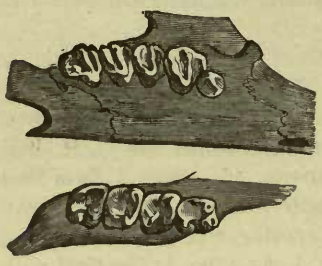
The true GROUND SQUIRRELS (*Tamias*) are distinguished from the rest of the Squirrels (*Sciurinæ*), and approach the Marmots, which form a second sub-family of Sciuridæ. Like some of the latter, they possess large cheek-pouches opening into the mouth. The ears in this genus are short; the fourth toe of the fore feet is longer than the rest, as in all the Sciurinæ; the limbs are short, and nearly equal in length; and the tail is shorter than in the true Squirrels. In general form and appearance, however, the Ground Squirrels greatly resemble the latter, except that they are rather stouter in the body. Four species of this group inhabit the continent of North America, where they are known as Chipmunks; and one of these, according to Mr. J. A. Allen, is identical with



COMMON CHIPMUNK.

the only known Old World species (*Tamias asiaticus*), which is found in North-eastern Europe and across Northern Asia, as far as the mouth of the Amoor, North China, and Japan. This species, which goes by different names in the different localities which it inhabits, and the COMMON CHIPMUNK (*Tamias striatus*) of the United States, agree very closely in all respects, and are exceedingly pretty little animals, with light-coloured fur adorned with darker stripes, varied in the case of the Chipmunk with streaks of white. They are from eight to ten inches long, including the tail. These animals live in burrows in the ground, and feed upon nuts, acorns, grain, and other seeds of various kinds, of which they lay up great stores in the autumn, carrying home their provisions in their cheek-pouches, which they stuff as full as they can hold. In this way they do no small damage to cultivated grounds near their haunts, plundering the corn and maize fields very freely; over eight pounds of corn in the ear are often found in the granaries of the Siberian form. The burrow is made deep enough to protect the animals from frost in winter, and the sleeping chamber contains a large nest of leaves and grass, in which several individuals, probably the parents with their grown-up family, sleep through the cold weather; but it must be remarked that their torpidity is very imperfect, and that they have frequent recourse to the supplies of food which they have stored up during the summer and autumn in separate chambers at the ends of lateral passages. These stores are so large that they generally greatly exceed the wants of the provident little animals,

and in the spring the residue is greedily devoured by Wild Pigs and Bears. Even the poorer human inhabitants of the countries frequented by the Ground Squirrels do not disdain to eke out their scanty means of subsistence by plundering the hoards of these animals. Many of them perish in severe winters, great numbers are destroyed by man, by the smaller Carnivora, and by birds of prey, but, nevertheless, they manage to hold their own, in consequence of the great fertility of the females, which produce several young twice in the year, namely, in May and August. At pairing time the males fight violently.



MOLAR TEETH OF THE MARMOT.

From the Ground Squirrels we pass, by a perfectly natural transition, to the MARMOTS (*Arctomyinæ*), the second sub-family of Sciuridæ. These animals differ from the preceding forms by their broader incisors, shorter tail, and stouter form of body, and by having the third finger longer than the rest. The first upper molar, also, is larger and more persistent than in the Squirrels, and the other molars differ in structure (*see* figure). The Marmots are all terrestrial animals, living and storing provisions in burrows, which they dig in the ground, and they are strictly confined to the northern parts of the two hemispheres.

The nearest approach to the Squirrels is made by the SPERMOPHILES (*Spermophilus*), several species of which occur in North America from Mexico to the Arctic regions, but never to the east of the great central prairie region; whilst in the Old World their domain extends from Silesia, through Russia, and across Asia, to the Amoor and Kamstchatka. The Spermophiles are Squirrel-like in form and have rather short tails, but in the American species this organ is generally longer than in those of the Eastern continent. On the thumb the claw is either very small or altogether wanting; the two series of molars are nearly parallel, and the mouth is furnished with large cheek-pouches. The ears are very small. These animals live in society, and prefer a dry, sandy, or loamy soil, in which they can easily make their burrows, which terminate in a chamber lined with grass and herbage, and have, besides, side-chambers, in which provisions can be stored for winter use. Like the other species of the family, the Spermophiles pass the winter in a state of partial torpidity. In the summer they are exceedingly lively and playful. Their food consists of roots, berries, and seeds of various kinds, and their winter stores of these articles are carried into the burrows in

STRIPED SPERMOPHILE, OR GOPHER.

their large cheek-pouches. The females are very prolific, producing from four to eight young at a birth, and in some cases even as many as ten have been found. The commonest and most widely distributed of the North American species is the STRIPED SPERMOPHILE, or GOPHER (*Spermophilus tredecimlineatus*), a pretty little creature of from six to eight inches long, usually of a

BURROWS OF THE PRAIRIE DOG.

chestnut brown colour with seven yellowish-white lines running along the back and between these six rows of small squarish spots of the same colour. This species extends its range from the Red River in Canada southwards as far as Texas, and is common on the prairies east of the Mississippi. This and some other species of the genus are said to be very carnivorous in their habits, preying upon small birds and mammals; and the Gopher was even described as feeding upon the flesh of Bisons, which it found lying dead on the prairies. The other American species are more local in their distribution; four of them occur in Mexico, and one of these is only known from that country. Of the Old World species the best known is the SISEL, or SUSLIK (*Spermophilus citillus*), which is abundant in Central and

Eastern Europe and in Siberia. Several other species are known from Asia Minor, Siberia, and Central Asia.

The Barking Squirrels, or Prairie Dogs, of which two species (*Cynomys ludovicianus*, *see* figure on p. 81, and *C. columbianus*) are found in the United States of America, are of a stouter form than the Spermophiles, and have the ears and tail short. The claws are well developed on all the toes of the fore feet, the cheek-pouches are shallow, and the two rows of grinding teeth converge towards the back of the mouth. These animals are peculiar to North America, where the former inhabits the prairies east of the Rocky Mountains, and the latter is found on the plains of the Columbia river, and in other parts of the western territories as far south as New Mexico. The best known of the two species is the *Cynomys ludovicianus*, to which the name of the Prairie Dog was first applied: this name being given to it from a fancied resemblance of its voice to the barking of a small Dog. It measures about a foot in length, and its tail is about four inches long. Its colour on the upper surface is reddish-brown, variegated with grey, and with a few scattered black hairs; the tail is flattened, and brownish-black towards the end, and the lower surface is brownish or yellowish-white. These animals live together in great societies, especially upon those portions of the prairies where the so-called buffalo-grass (*Sesleria dactyloides*) grows most luxuriantly, this grass and succulent roots constituting their chief food. They live in burrows, which they dig in the ground at a distance of twelve or fifteen feet apart; a hard-beaten path runs from burrow to burrow, and would seem to give evidence of the sociable disposition of the animals; and at the mouth of every burrow there is a little hillock, formed by the earth thrown out of it, which serves the occupant as a watch-tower. These burrows are usually so numerous upon favourable pieces of ground that the space occupied by them is quite populous, and presents a scene of considerable animation when the inhabitants are out in the pursuit of their business or their pleasure, and hence they are in common parlance spoken of as "towns" or "villages." Their curious appearance is heightened by the almost constant presence in them of numerous small Owls, of the species known as the Burrowing Owl (*Athene cunicularia*), a widely-spread species, which in some places digs its own subterranean habitation, but on these prairies saves itself the trouble by taking possession of the deserted abodes of the Prairie Dogs. These birds are diurnal in their habits, and are to be seen mixed up with the Prairie Dogs in their settlements. Another inhabitant of the burrows is the Rattlesnake; and some of the earlier observers thought that the Prairie Dogs, Owls, Rattlesnakes, and some other animals, such as Horned Frogs and an occasional Tortoise, occupied the same burrow, and lived there on the most amicable footing. Unfortunately, this paradisaic picture is an imaginary one. It is true that the Rattlesnake does take up his abode in the Prairie Dog's burrows, but he either selects a deserted one, or dispossesses, and perhaps devours, the rightful owner; and his object in his residence among the lively little Marmots is anything rather than peaceful, as they constitute his favourite food. The little Burrowing Owl has also been said by some writers to feed on the young Prairie Dogs; but this is not proved, and the food of the Owls is known to consist chiefly of Grasshoppers and Crayfish. According to the latitude in which they live, the Prairie Dogs seem to be more or less subject to torpidity during the winter.

The true Marmots (*Arctomys*) are nearly related to the Prairie Dogs. They are stout in the body, have a short tail, and a rudimentary thumb with a flat nail; and are either entirely destitute of cheek-pouches or have mere indications of those organs. The rows of molar teeth are placed nearly parallel to each other in each jaw. The skull is broad and flat above, with a depression between the orbits; and the post-orbital processes are larger than in any other Sciuridæ. The Marmots are confined to the Northern hemisphere, but over it they are widely distributed in both continents. Of the Old World species, the best known are the Bobac (*Arctomys Bobac*) and the Alpine Marmot (*A. Marmota*), of which the former extends from the south of Poland and Galicia over the whole of Southern Russia and Siberia to the Amoor region and Kamstchatka, whilst it is found in elevated situations as far southward as Cashmere, Tibet, and the Himalayas; and the latter inhabits only the higher regions of the Alps, Pyrenees, and Carpathians. In North America the common species is the Woodchuck (*Arctomys Monax*), the distribution of which is from the Carolinas northward to Hudson's Bay, and westward from the Atlantic coast to Missouri, Iowa, and Minnesota; the Rocky Mountain region is inhabited by a distinct species (*A. flaviventer*); and a third very large species, the Hoary Marmot, or Whistler

ALPINE MARMOT.

(*A. pruinosus*), which measures from twenty-three to twenty-five inches in length of body, appears to be most abundant in the north-western parts of the continent, and is said to range northward as far as the Arctic Circle. The Marmots live usually in large societies in extensive burrows, which they form underground; and in some localities, as on the great plains of Russia and Siberia, their dwelling-places are described as producing a remarkable effect, owing to the multitude of little hillocks formed by the earth thrown out of their burrows. During the summer they are in a state of constant activity, playing and running about in search of food in the neighbourhood of their dwellings. The winter they pass in a state of torpidity, in a comfortable chamber lined with soft herbage, and protected from the outside cold by the closure of the main passage leading into their abode. For a time after their retirement for the winter they continue active in their domicile, and feed upon the stores of food which they have laid up during the summer; and as a preparation for their winter sleep, they become exceedingly fat during the autumn. The Marmots are the largest members of their family, and, indeed, some of them may be reckoned among the larger Rodents. The Alpine Marmot measures more than twenty inches in length, and the Bobac about fifteen inches, exclusive of the tail.

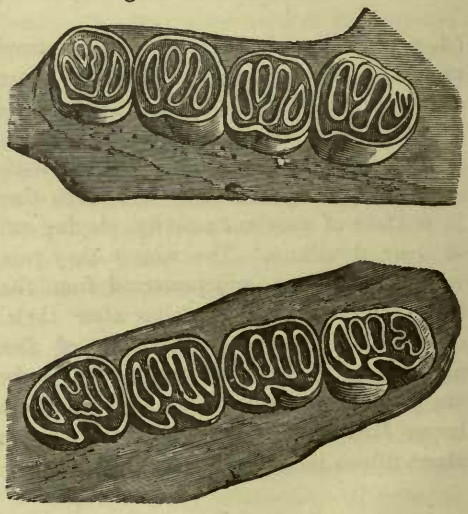
FAMILY II.—ANOMALURIDÆ.

Some curious African animals, closely resembling the Flying Squirrels, and at first regarded as belonging to that group, were formed by Mr. Waterhouse into a distinct genus, which he called *Anomalurus*, in allusion to the peculiar characters presented by their tail. This organ, which is long and well clothed with hair, although not so bushy as in the true Squirrels, has on the lower surface of its basal portion a double series of horny scales, which project from the skin, and probably serve to assist the animal in climbing upon the branches of trees.

Besides this peculiarity, these animals exhibit certain other characters which have induced modern

zoologists to separate them from the Squirrels as a distinct family. Thus, the post-orbital processes are wanting, or nearly so; the infra-orbital openings are large; the molar teeth are four in number on each side, above and below, nearly equal in size, and not tubercular, but with a flat surface, crossed by transverse loops of enamel; and the palate is contracted in front and deeply notched behind. In the skeleton we find sixteen pairs of ribs, whereas in the Squirrels there are only twelve or thirteen pairs; and the internal anatomy, first described by Mr. Alston, is very peculiar. The flying membrane is quite as largely developed as in the Flying Squirrels, and is in the same manner extended from the wrists to the heels, and further supported by cartilaginous spurs starting from the fore limbs; but, whilst in the Flying Squirrels this spur springs from the wrist itself, in the Anomalures it projects from the elbow, and thus produces a still greater extension of the membrane. The ears are well developed, the eyes large, and the general aspect both of head and body completely squirrel-like. Six species of this family have been described, all from the West Coast of Africa. One of them occurs in the island of Fernando Po. The species figured (*Anomalurus fulgens*) is from the Gaboon. It is a handsome little creature, of a bright reddish colour, paler below, and having a small white spot between the ears. Its length is fourteen inches, and its tail is seven inches long. In some of the other species the tail is as long as the body. Of the habits of these animals little is positively known, but they are said to feed upon fruits. They probably resemble the Flying Squirrels in their general mode of life.

FULGENT ANOMALURE (From the *Proceedings of the Zoological Society*).



MOLAR TEETH OF THE ANOMALURE.

FAMILY III.—HAPLODONTIDÆ.

This is another small family, smaller even than the preceding one, for it includes only a single known species, limited in its range to the western coast of North America. This is the Sewellel, a little Rodent, first observed by the American travellers, Lewis and Clarke, in 1805 or 1806, described in 1814 by Rafinesque under the name of *Anisonyx rufa*, and afterwards, in 1829, by Sir John Richardson, as the type of a new genus, as *Aplodontia leporina*. This generic name has been corrected, in accordance with its derivation, by more recent writers, to *Haplodon*, from which the name of the family has been formed.

In this animal there are five molars in the upper and four in the lower jaw; the first upper molar

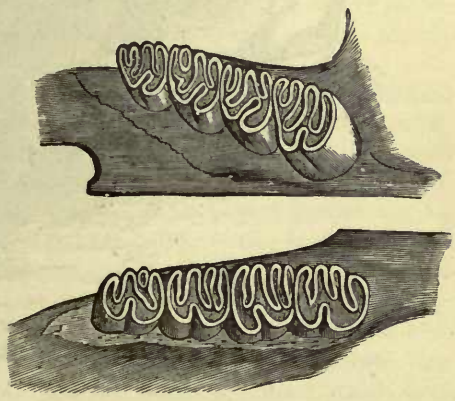
is very small, and all these teeth are rootless, simple, and prismatic, the surface of each tooth being surrounded by a mere border of enamel. The skull is very flat, very wide behind, and furnished with large zygomatic arches; between the orbits and in front it is much contracted, and there are no post-orbital processes. In the lower jaw the angular portion is twisted so as to form a horizontal ridge. The body is stout and clumsy, the tail very short, and the claws of the fore feet (which are five-toed, as well as the hind ones) are very powerful; in fact, as Dr. Coues says, "The whole organisation, viewed externally, indicates terrestrial and highly fossorial habits."

The Sewellel (*Haplodon rufus*) is about a foot long, with a tail of an inch or an inch and a half; its colour is brownish, with an intermixture of black hairs, lighter and more greyish below. The whiskers, claws, and upper surface of the feet are whitish, and the incisor teeth yellow. It inhabits the Washington and Oregon territories, from the Rocky Mountains to the shores of the Pacific, and extends also into the southern portions of British Columbia and the upper parts of California.

The Sewellel is described as having very much the same habits as the Prairie Dog, living in society, burrowing very readily in the ground, and feeding on roots and berries. Their companies, however, seem to be much smaller than those of the Prairie Dog, and they are said chiefly to frequent spring-heads in rich, moist places. They are described as having the curious habit of neatly cutting off some herb or plant, which, when packed in bundles, they lay out and expose to the sun to dry; this is probably for the purpose of storing for winter consumption. It seems to be uncertain whether the Sewellel is torpid during the winter, but probably in this respect it varies according to local conditions or the coldness of the seasons. Dr. Suchley believes that the Sewellel has several litters of young during the season. The Indians trap them, and esteem them very highly as food. Cloaks or blankets are made of their skins, which are sewn together with fibres derived from the sinews of the Elk and Deer. A robe described by Sir John Richardson was composed of twenty-seven skins.

FAMILY IV.—CASTORIDÆ.

Unlike as the Beaver may be to a Squirrel, it yet presents many characters which prove that its nearest affinity is to the animals which compose the group Sciuromorpha. This relationship has indeed been overlooked by many zoologists, but Mr. Alston and Mr. Allen have clearly shown that Professor Gervais was right in placing the Castoridæ in close juxtaposition with the Squirrels. The peculiarities which make the apparent discrepancy so striking are indeed chiefly those by which the Beaver is adapted to an aquatic life.



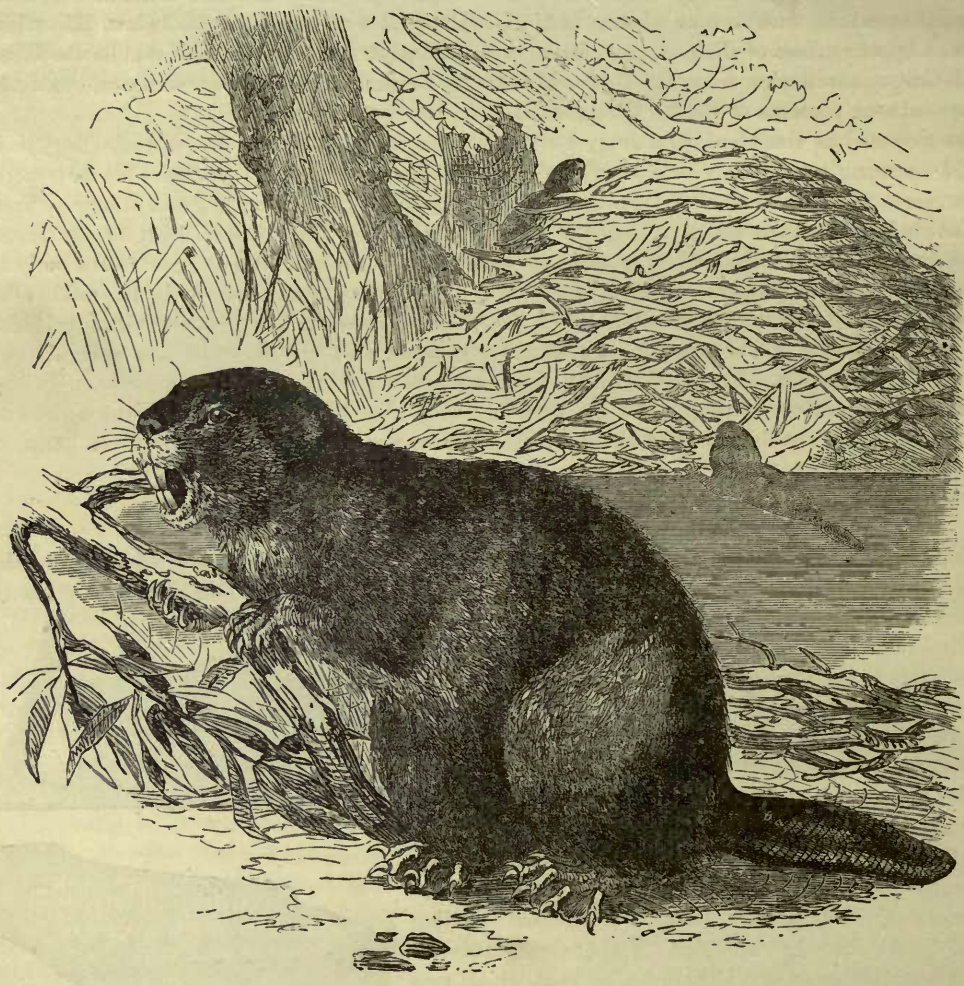
MOLAR TEETH OF THE BEAVER.

The Beaver, which is the sole living representative of this family, is a more powerful animal than any of the preceding, and his incisor teeth and the means of working them are especially well developed. The head is large and the skull massive, and furnished with a distinct median (sagittal) crest for the insertion of the strong muscles which move the lower jaw. There are no post-orbital processes. There are four molars on each side in each jaw, and these are nearly similar in size and structure; but, contrary to what we have seen in the preceding groups, the first molar is the largest, and the others diminish in size towards the hinder end of the row. The series of teeth in the two sides of the mouth converge toward the front; and the teeth themselves, which are for a long time rootless, and only close up to form a simple root when the animal grows old, show three folds or loops of enamel on one side, and a single fold on the other: the three folds entering from the outer surface of the tooth in the upper jaw, and from its inner surface in the lower.

The general form is stout and heavy, especially in the hinder parts; the tail is of moderate length, broad, flattened, and covered with a scaly skin; the feet are all five-toed, the fore pair considerably smaller than the hinder, but all well furnished with claws, and the hinder pair fully webbed to the extremities of the toes. The wrist has a large ossicle, in addition to those usually

composing that part of the body. The eyes are small, have the pupil vertical, and are furnished with a nictitating membrane; the ears are small and short, and their antitragus can be so applied to the head as almost entirely to close the auditory aperture; and the nostrils are also so arranged as to be capable of closing.

The Beaver is usually about two feet and a half long, and is, therefore, one of the largest of the Rodentia, except the Capybara. The tail, which is flattened above and below, and of an elongated oval form, measures about ten inches. The muffle is naked; the ears scaly; the soles of all the feet are



BEAVER.

naked, and their upper surfaces clothed with hairs; and the second toe of the hind feet is usually furnished with a double claw, the additional one being placed beneath the other. The general colour of the fur is reddish-brown on the upper surface, lighter and greyish below. The colour varies a little in different individuals, and appears to become darker, or even blackish, in northern localities. White or pied individuals are not uncommon. The Beaver appears to increase in size for some years after it has attained maturity. Mr. Allen says that in America "two-year-old Beavers generally weigh about thirty-five to forty pounds, while very old ones occasionally attain a weight of upwards of sixty." The size of the skull seems to increase throughout life; the thickness and density of the bones also increase, and the ridges for the attachment of the muscles become stronger in old individuals.

The Beaver is, or has been, distributed generally over all the northern parts of the Northern hemisphere, especially in the forest regions. Formerly it ranged over the whole of Europe, including

the British islands, where there is historical evidence of its former existence, besides the skulls and bones which have been found in various places, but especially in the Fen lands. At present the animal appears to be completely exterminated in the southern parts of Europe from France southwards, with the exception of a small colony on the Rhone, which we believe is still in existence; and only a very few individuals survive in Germany, where they are found on a tributary of the Elbe, and in one or two other places. In some parts of Poland, Russia, and Austria, and in the Scandinavian peninsula, they still, to a greater or less extent, hold their ground; and in Asia they abound about the rivers of Siberia, and in the streams which flow into the Caspian Sea. In North America Beavers formerly abounded from Texas, and, according to manuscript evidence cited by Mr. Allen, even from Mexico, northward to the extreme limit of forest growth, and from the Atlantic to the Pacific coast. The constant pursuit to which the animals were subjected, in consequence of the demand for their skins, greatly diminished their numbers, and in many localities altogether exterminated them; but they still occur over a very large extent of the North American continent, especially in the western territories, where they are even abundant in some of the wilder parts.

In the preceding statements we have spoken of the Beaver as forming a single species; but it has long been a moot question with zoologists whether the Beavers of the Old and New Worlds were or were not specifically identical. The external differences are very slight, and those observed in the skull, upon which most stress has been laid, do not appear to be of sufficient importance for the separation of the animals as distinct species. They consist chiefly in the greater breadth of the anterior portion of the skull, including the inter-orbital space; the extension farther back of the nasal bones, the greater size and depth of the basilar cavity and the more anterior position of the auditory bullæ, in the European Beaver; but the examination of large series of specimens has proved that the skulls from both hemispheres present many exceptions, in which one or more of the peculiarities which they ought to exhibit do not occur: a circumstance which of necessity greatly invalidates the distinction founded upon such characters. Dr. Ely sums up the results of an extended investigation in the following words:—"The extremes of difference, in their aggregate, on the one side and on the other, are sufficiently striking to justify us in regarding them as varieties of one and the same species; while the want of constancy in these peculiarities suggests the inference that these variations are due to long separation of the races, and to accidental causes, rather than to original diversity of the stock." The Beaver may thus be regarded as a species with two geographical forms (varieties or subspecies), viz., *Castor fiber*, var. *europæus*, and *Castor fiber*, var. *canadensis*.

So much has been written upon the habits of the Beaver, that the following short statement will suffice to give the leading facts in the natural history of the animal, the accounts of the marvellous sagacity of which, given by the older writers, have, perhaps, invested it with an exaggerated interest.

In populous countries the Beaver is contented, like the Otter, with a long burrow for his residence; but in the wilder regions of Siberia and North America his dwelling-place is a much more complicated affair. But even in these regions, according to some authorities, a certain number of Beavers—always males—show a lazy unwillingness to take part in the common labours of the colony; and these, as idlers, are expelled from the community, often with rather severe treatment, and then take up their abode by themselves in holes, which they dig out in the banks of rivers, whence they are called "terriers." On the other hand, it would appear that the building instinct which is so remarkably manifested by the Beaver is not always extinct even in those which inhabit populous countries, for we have a most interesting account from M. Meyerinck of the construction of a lodge, and even of a dam, by the colony of Beavers on a tributary of the Elbe.

In North America, from which we have the fullest accounts of the habits of the Beavers, these animals select for their habitation some small stream running through a locality well covered with trees, especially willows, birches, and poplars, upon the bark of which they chiefly feed. These trees they cut down with their powerful incisor teeth, usually selecting those from the thickness of a man's arm to that of his thigh, but sometimes even felling trunks eighteen inches in diameter. The operation, which at first sight would seem to be a rather difficult one for an animal like the Beaver to perform, is effected by gnawing all round the trunk for a certain distance, and gradually working deeper and deeper into its substance in the middle of the part attacked, until at length the tree stands

upon quite a slender piece of wood, with the trunk both above and below this tapered off into the form of two cones, united by their apices. The work is done as sharply and neatly as if the wood had been cut away by a chisel; and the animals are said to have the sagacity to weaken the trunk more on the side that looks towards the water than on the opposite side, by which means, when it falls, it will generally do so in the direction of the water, which materially facilitates the further operations of the Beavers. The quantity of trees cut down by them in this way is very great, so that in the neighbourhood of a Beaver encampment the ground is everywhere full of the stumps which they have left.

These tree trunks are then cut up into lengths of five or six feet, which, after their bark has been stripped off and eaten, are employed in the formation of a lodge, to serve as a shelter for the company of Beavers forming it. Access to the lodge is obtained by means of several subterranean passages, which always open under water, and lead up into the chamber occupying the interior of the lodge. The lodge is usually of an oven-like shape, and is built close to the edge of the water; its walls are very thick, and composed of the above-mentioned trunks of trees, plastered over with mud, clay, &c., mixed with grasses and moss, until the whole fabric measures from twelve to twenty feet in diameter, and forms a hill some six or eight feet high. The larger lodges are in the interior about seven feet in diameter, and between two and three feet high; and the floor of this spacious chamber is covered with fine chips of wood, grasses, and the soft bark of trees, which serve to form the beds of the occupants. Occasionally the lodges are said to contain store-rooms. In front of the lodge, according to Audubon, the Beavers scratch away the mud of the bottom until they make the water deep enough to enable them to float their pieces of timber to this point, even when the water is frozen; and, communicating with this, a ditch surrounds the lodge, which is also made so deep that it will not readily freeze to the bottom. Into this ditch, and the deep water in front of the lodge, the passages by which access to the water is obtained always open, and thus the inhabitants can at any time make their way out when their business requires them to do so. In the neighbourhood of the lodge the timber cut into lengths, as above described, is piled up, so as to furnish a supply of food as it is required; and the pieces of timber, after being stripped of their bark, are usually employed by the Beavers either in repairing their lodges or in constructing or strengthening the dams which they very frequently throw across the streams haunted by them. These dams, which are destined to keep the water of variable streams up to the necessary height for the convenience of the Beaver, are wonderful pieces of work, and almost justify the marvellous stories told of its intelligence and sagacity by the older writers. They are often of great length—sometimes 150 or 200 yards and more—and run across the course of the brook inhabited by the Beavers—sometimes in a straight line, sometimes in a curved form, according to peculiarities in the ground or the stream, and the exigencies of the engineers. They are composed, like the lodges, of lengths cut from the trunks and branches of trees, filled in with smaller sticks, roots, grasses, and moss, and all plastered with mud and clay in a most workmanlike manner, until the whole structure becomes quite water-tight. Their height is from six to ten feet, and their thickness at the bottom sometimes as much as double this, but diminishing upwards by the slope of the sides until the top is only from three to five feet wide. These dams convert even small rivulets into large pools of water, often many acres in extent; and in districts where Beavers abound these pools may occupy nearly the whole course of a stream, one above the other, almost to its source. Their use to the Beavers, as constantly furnishing them with a sufficiency of water in which to carry on their business, and especially to float to their lodges the tree trunks necessary for their subsistence, is easily understood; but it is a more remarkable circumstance that by this means the Beavers exercise a considerable influence upon the external appearance of the locality inhabited by them, which may persist even long after they have themselves disappeared. In and about the pools the constant attacks of the Beavers upon the trees produce clearings in the forest, often many acres in extent; at the margins of the pools the formation of peat commences, and under favourable circumstances proceeds until the greater part of the cleared space becomes converted into a peat-moss. These peaty clearings are known as Beaver-meadows, and they have been detected in various countries where the Beaver is now extinct.

As in the case of the majority of Rodents, the chief activity of the Beaver is nocturnal; and it is only when driven from its lodge by a high flood, or in the wildest and most sequestered localities, that

it goes about during the day. It swims quickly, but entirely by the agency of the hind feet, the fore feet being used chiefly for carrying and building operations, and for conveying the food to the mouth. Before diving, it is said to slap the surface of the water with its tail, producing a sound that may be heard at a considerable distance. On land it sometimes travels a good way in the warm season, and is then stated to indulge in a change of diet, feeding upon roots and fruits, and sometimes upon corn. The roots of the water-lily (*Nuphar*) are also said to constitute part of its food. The Beaver is hunted —but less now than in former years—for the sake of its skin, the soft under fur of which was much used in the manufacture of hats. It is asserted that the flesh is very good, but according to some authorities, only certain parts of it are palatable; and Audubon declares that the tail, which is regarded as a peculiarly choice morsel, closely resembles marrow, and is so rich that only those whose stomachs are incapable of being upset by greasy food can eat more than a very little of it.

The Beaver has been hunted not only for its fur, but also, and from time immemorial, for the sake of a peculiar secretion produced by it, which, under the name of *Castoreum*, has been for many centuries a highly-esteemed medicament. This substance is secreted in a pair of glandular pouches, situated in the inguinal region of the male Beaver; and it would seem that it was almost entirely in order to procure these that the ancients hunted this animal. Even in connection with this they had wonderful tales to tell of its sagacity: as how that, when it was pursued and found itself unable to escape, it would throw itself upon its back, as if to invite the hunter to take what he wanted and spare its life. Nay, some ancient writers seem to have believed that the Beaver would go the length of biting off its own castoreum glands, and leaving them for the hunter to pick up! Castoreum contains some volatile oil and resin, and a peculiar crystallisable substance called castorine; it is used in medicine as a stimulant, and seems to act especially on the nervous system, but is not much employed nowadays. Its odour, which appears to spread over a considerable space, is described as being very attractive to other Beavers. Audubon states that it is used for this reason as a lure by the American trappers.

CHAPTER II.

THE DORMOUSE, LOPHIOMYS, RAT, AND MOUSE FAMILIES.

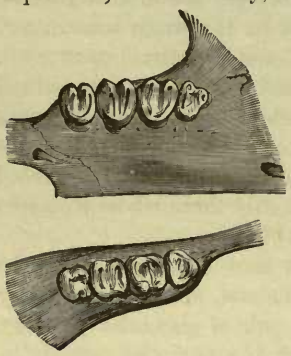
THE MOUSE-LIKE RODENTS—MYOXIDÆ—Characteristics—THE DORMOUSE—Description—Habits—Activity—Food—Winter Condition—THE LOIR—THE GARDEN DORMOUSE—LOPHIOMYIDÆ—How the Family came to be Founded—THE LOPHIOMYS—Milne-Edwards' Opinion—Skull—General Form—Habits—MURIDÆ—Number of Species—Characteristics —Variety of Forms—Distribution—The Murine Sub-Family—THE BROWN RAT—History—Fecundity and Ferocity—Diet—At the Horse Slaughter-houses of Montfaucon—Shipwrecked on Islands—Story of their Killing a Man in a Coal-pit—In the Sewers of Paris and London—THE BLACK RAT—THE EGYPTIAN RAT—THE COMMON MOUSE—Habits —Destructiveness—Colours—THE LONG-TAILED FIELD MOUSE—Description—Food—THE HARVEST MOUSE—Description—Habits—In Winter—Agility—Their Nest—THE BANDICOOT RAT—THE TREE RAT—THE STRIPED MOUSE—Allied Genera—THE WHITE-FOOTED HAPALOTE—The American Murines—THE WHITE-FOOTED, OR DEER MOUSE—THE GOLDEN, OR RED MOUSE—THE RICE-FIELD MOUSE—THE AMERICAN HARVEST MOUSE—THE FLORIDA RAT—Description —Their Nest—Food—Mother and Young—THE BUSHY-TAILED WOOD RAT—THE COTTON RAT—THE RABBIT-LIKE REITHRODON—THE HAMSTERS—Characteristics—Appearance—Distribution—Burrows—Disposition—Food—Habits—THE TREE MICE—THE BLACK-STREAKED TREE MICE—THE GERBILLES—Characteristics—Habits—Other Genera—THE WATER MICE—Characteristics—Species—THE SMINTHUS—THE VOLES—Characteristics—THE WATER VOLE—Appearance—Distribution—Food—THE FIELD VOLE—THE BANK VOLE—THE SOUTHERN FIELD VOLE—THE SNOW MOUSE—THE ROOT VOLE—THE MEADOW MOUSE—THE PINE MOUSE—THE MUSQUASH, MUSK RAT, OR ONDATRA—Distinguishing Features—Habits—His House—THE LEMMING—Description—Food—Habits—Disposition—Their Extraordinary Migrations—Other Lemmings—THE ZOKOR.

SECTION II.—MOUSE-LIKE RODENTS (*MYOMORPHA*).

THE Myomorphic, or Mouse-like group of Rodents, includes a much greater variety of forms than the preceding, and the number of species is also very great. We find in it arboreal, terrestrial, and aquatic species; and in the second of these categories some presenting almost every variety of habit which the Rodent type is capable of assuming. Naturally the families and sub-families into which it is divided are rather numerous. Mr. Alston distinguished seven family groups, the first of which is the Myoxidæ.

FAMILY V.—MYOXIDÆ.

The Dormice, which constitute this family, have generally been regarded as nearly related to the Squirrels; and certainly, although they fall under the definition of the Myomorphic section, they have a plain affinity to the Sciuridæ. In form they are Squirrel-like, and the tail is long and hairy, although not so bushy as in the true Squirrels. They have four molars on each side in each jaw (*see* figure), the front one in each series being smaller than the rest. All these teeth are rooted, and their crowns show transverse folds of enamel. The frontal bones are much narrowed; the fore limbs are small, with the thumbs rudimentary and furnished with a small flat nail; and the hind feet have five toes. The Dormice differ from all other Rodents by having the intestine entirely destitute of a cæcum. They are confined to the Eastern hemisphere, and chiefly to its temperate and colder regions; although a species of *Myoxus*, and some forms on which a special genus (*Graphiurus*) has been founded, inhabit Africa. The number of known species is only about a dozen.



MOLAR TEETH OF THE DORMOUSE.

The common Dormouse (*Myoxus avellanarius*) is an elegant little creature, about three inches long, with a somewhat bushy, cylindrical tail, two inches and a half in length. Its fur is of a light reddish-tawny colour above, becoming paler and yellowish on the lower surface. On the throat there is a small whitish mark. It is

DORMOUSE.

widely distributed in Europe, ranging from Britain and Sweden in the north to Tuscany and Northern Turkey in the south. Generally it is more abundant in southern than in northern countries, but in the south of France it is less common than either of the other two European species. Eastwards it does not extend beyond Galicia, Hungary, and Transylvania.

The Dormouse is nocturnal in its habits. During the day it sleeps in its nest or in some snug retreat, and at night comes forth in search of its food, which consists of nuts, acorns, seeds, berries, and the buds of trees and shrubs. It is particularly fond of the nuts of the common hazel, whence its specific name, and the name of "Haselmaus," which it bears in Germany; these nuts it is said to pierce and empty without plucking them or taking them out of their cups. The Dormouse lives in small societies in thickets and hedgerows, where it is as active in its way amongst the bushes and undergrowth as its cousin the Squirrel upon the larger trees. Among the small twigs and branches

of the shrubs and small trees the Dormice climb with wonderful adroitness, often, indeed, hanging by their hind feet from a twig in order to reach and operate on a fruit or a nut which is otherwise inaccessible, and running along the lower surface of a branch with the activity and certainty of a Monkey. Detached articles of food are held up to the mouth by the fore paws, after the fashion of a Squirrel. Towards the winter the Dormouse becomes exceedingly fat, and having collected a small store of food, makes for itself a little globular nest, composed of small twigs, leaves, pine-needles, moss, and grass, and within this, coiled up into a ball, passes into a torpid state.

Nevertheless, the winter sleep is not wholly uninterrupted; on mild days the Dormouse wakes up for a time and takes a little of its stored-up food. The female produces usually about four young, in the spring according to Professor Bell, in August according to Brehm; but the former writer thinks that in some cases two broods are produced in the year, as he has received from the same locality in September a half-grown Dormouse and three very young ones, evidently not more than a fortnight or three weeks old.

Of the other common European species, the LOIR (*Myoxus glis*) is found only in southern regions, its range extending from Spain to Southern Russia, and passing into the neighbouring parts of Asia. It is considerably larger than the Dormouse, measuring rather more than six inches in

GARDEN DORMOUSE.

length, and has a bushy tail, in which the hairs are arranged in two rows, as in that of the Squirrel. The habits of this species are like those of the Dormouse. Fruit constitutes a portion of its diet, and it is said also to destroy and devour small birds and other animals. The Loir is a very voracious feeder, and becomes exceedingly fat in the autumn. By the ancient Roman epicures it was regarded as a dainty morsel, and they spared no pains to fatten it for the table. It sleeps during the day, and hibernates in some hole in a tree or in the ground, and the nest is formed in the former situation. The female usually produces about six young.

The GARDEN DORMOUSE, or LEROT of the French (*Myoxus nitela*), is common all over the southern and western parts of the Continent, extending northwards through Germany into the Baltic provinces of Russia. It is a little smaller than the preceding species, which, however, it resembles in its general habits; but it dwells commonly in gardens, and feeds on fruits, often doing much damage to the choicer varieties. It is a lighter and more active animal than the Loir, and is said to be even more predaceous in its habits. The female produces from four to six young, sometimes in a beautifully-made nest of her own, sometimes in the deserted or usurped nest of a Blackbird or Thrush, or in that of a Squirrel.

FAMILY VI.—LOPHIOMYIDÆ.

The importance of an animal in the zoological system by no means depends either upon its size or on its abundance in the world; its rank in the classification is decided solely by peculiarities of

organisation which distinguish it more or less from its fellows; and in many cases the creatures which are regarded with the most interest by the naturalist are those which seem most to withdraw themselves from general observation. A single genus, perhaps containing only one or two species, may, by a singular combination of characters, be so completely isolated from all the recognised allied groups that it cannot be placed in any of them, and accordingly a distinct family, possibly even an order, has to be established for its reception. Sometimes subsequent discoveries add to the number of species forming the group thus set up, and in this way the prescience of its founder is confirmed. Sometimes the group remains in its original condition, leaving us, according to circumstances, to regard the anomalous creatures of which it is composed either as a special development of their general type, or as the residue of a group which may have presented a greater variety of forms at some past period of the earth's history.

SKULL OF LOPHIOMYS.

The latter is perhaps the case with the curious little Rodent which alone forms the present family, of which its original describer, M. Alphonse Milne-Edwards, writes as follows:—"In its general aspect it somewhat resembles certain Opossums, and like these it is pedimanous;* but these are the only analogies it presents to the Marsupials, and in its dental system, as also in the rest of its organisation, we easily see that it belongs to the order Rodentia. It differs, however, from all the members of this group by characters of considerable importance; I may even say that, by some peculiarities of structure it departs from all other Mammals, and that we find in it anatomical arrangements of which we have hitherto had examples only in the class of Reptiles." After an exhaustive discussion of the characters of this curious little animal, M. Milne-Edwards comes to the conclusion that it is most nearly related to the members of the following family, and especially to the Hamsters, although he found it impossible to unite it with them. In this course he has been followed by other writers.

The general construction of the skull is the same as in the Muridæ, but from the temporal ridges thin plates are developed, which bend downwards, and articulate with similar plates springing from the malar bones, and thus completely arch over the temporal fossæ after a fashion only met with in certain reptiles, and especially in the Hawksbill Turtle (*Chelone caretta*). The whole upper surface of the skull is covered with minute but perfectly definite granules, arranged with much regularity, and these, which occur in no other Mammal, give the skull a very peculiar aspect, such as may be seen in some fishes. As in the Muridæ, there are three molars on each side in each jaw, and these are rooted and strongly tubercular; the foremost in each series having three and the others each two ridges. Without entering in detail into the peculiarities described at great length by M. Milne-Edwards, we may say that in its general structure, and especially in that of the skeleton, the animal is murine, but with a very important distinction, namely, that the collar bones, which are well developed in the Rats and their allies,

LOPHIOMYS.

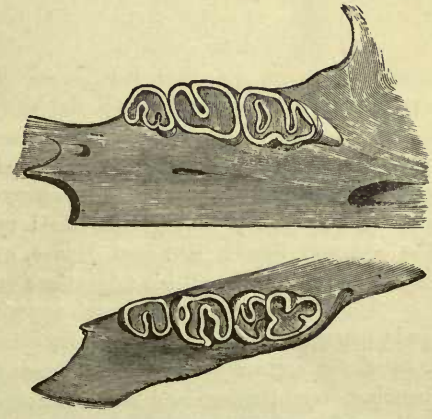
* Having the hind feet hand-like.

are here reduced, as in the Hares and Rabbits, so as to form only two small bony styles freely suspended among the muscles, and that the first toe in the hind feet, although not very long, is so attached as to be opposite to the rest, thus converting the organ into a prehensile hand which the animal uses freely in climbing. The cæcum is small.

In its external characters this animal is as remarkable as in its anatomical structure. In general appearance, as stated by its describer, it has much resemblance to a small Opossum, but the bushy tail and the peculiar arrangement of the hair on the body are met with in no Marsupials. The head is small; the general form stout; the limbs short, and the hind ones not much longer than their fellows; and the ears are of moderate size and sparingly clothed with hair. The prevailing colour is blackish-brown, but a triangular spot on the forehead, a streak under each eye, and the tip of the tail, are white; and the long hairs which clothe the body and tail are dark only in the middle, the base and tip being white, as are also a great quantity of finer and shorter hairs which form a sort of under fur. But the chief peculiarity of the coat is to be found in the arrangement of the hairs of the body. The long hairs of the middle of the back and tail, some of which are nearly three inches in length, are capable of being raised into a nearly upright position, forming a sort of crest which gives the animal a very peculiar aspect, and this crest is separated from the pendulous hair of the flanks by a sort of furrow clothed with very peculiar hair of a greyish-tawny colour. These hairs are unlike any others known to occur among Mammals. The apical part is of the ordinary construction; but the following portion down to the base is "very rugose, and presents a spongy aspect, due to the interlacing, and, so to speak, felting of a multitude of epidermic filaments emanating from radiate cells, which constitute a perfect network of irregular meshes. Within the sort of sheath thus formed longitudinal filaments which break up into bundles of fibrils are to be seen."

Very little is known as to the habitat of this animal, which M. Milne-Edwards has named *Lophiomys Imhausi*, the former name referring to the crested character of the back, the second commemorating the person who first brought the creature to the notice of naturalists. M. Imhaus, stopping for a few hours at Aden on his way home from Réunion, saw a living specimen of this Rodent in the possession of a negro from whom he bought it, but could learn nothing as to its origin. He inferred, however, that it had not been brought very far, and that its native country was either Southern Arabia, or some region in Abyssinia, or Nubia, on the other side of the Red Sea. This specimen was brought to France, and lived for about a year and a half in the Garden of Acclimatization in the Bois de Boulogne, where it fed upon maize, vegetables, and bread, slept during the day, and climbed with ease upon chairs and other convenient objects by the aid of its hinder hands. It never took its food in the fore-paws to carry it to the mouth as so many Rodents do. When irritated it elevated the crest right down to the end of the tail, and defended itself by biting vigorously.

It is doubtful whether the *Lophiomys* inhabits Arabia, but it is found in the neighbouring parts of Africa. Professor Peters described the skull of the animal as representing a new generic type under the name of *Phractomys æthiops*. His specimen was obtained by Dr. Schweinfurth from the tombs of Maman, north of Kassala, in Upper Nubia. A third specimen has been brought from Keren in the Bogos country, and a fourth from the Erkanid mountains between Suakim and Singat.



MOLAR TEETH OF THE BLACK RAT.

FAMILY VII.—MURIDÆ.

We come now to the largest and most typical family of the Rodents: that, namely, which includes the Rats and Mice and their numerous allies. Mr. Wallace estimates the number of known species at 330, which is probably within the mark. All these forms agree in the following characters:—The lower incisors are compressed; the molars are usually three in number on each side in each jaw, in one genus only two in the lower or in both jaws, and in another four in both jaws. They are rooted or rootless, tubercular or flat, with folds of

enamel; the malar bone is short and slender, generally reduced to a mere splint between the maxillary and squamosal processes of the zygomatic arch; the thumb is rudimentary, but often furnished with a small nail; and the tail is generally scaly, with a few scattered hairs, densely hairy only in a few species.

As might be expected in so large an assemblage of species, the variety of forms is very great among the Muridæ, but broadly, the common Rats and Mice, which are only too well known to most of us, may serve as characteristic types of the whole series. The family, however, includes jumping forms, swimming forms, arboreal forms, and burrowing forms, in which the peculiarities of the life-habits are very distinctly indicated by the external appearance of the creatures. In their distribution the Muridæ are almost absolutely cosmopolitan, the family being represented in

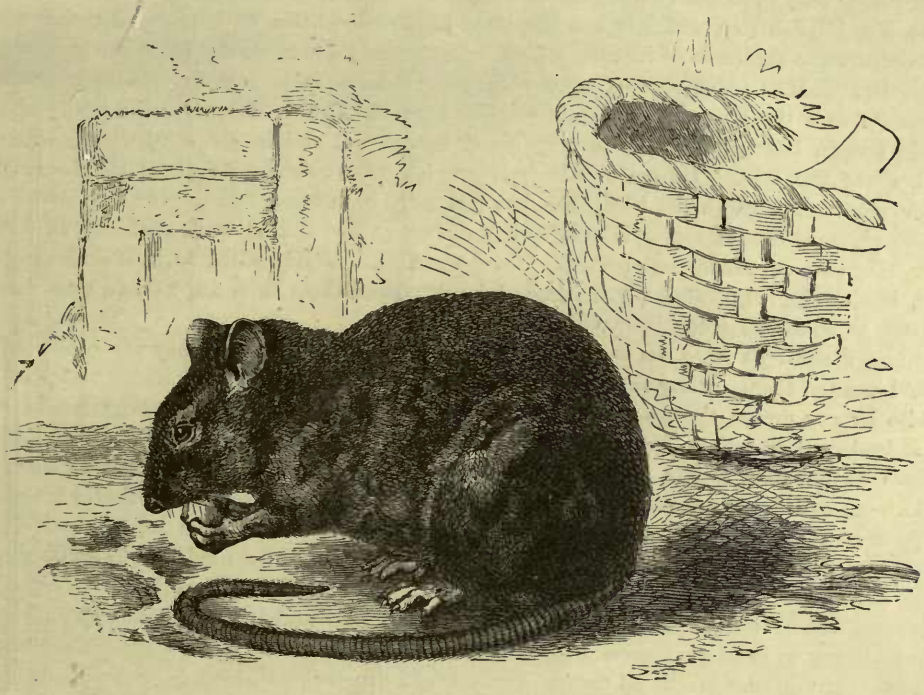
BROWN RAT.

every part of the world, with the sole exception of the islands of the Pacific Ocean. Australia possesses about thirty species of the family. New Zealand, at the time of its discovery, harboured a Rat, known as the Forest Rat, or Maori Rat, which was a favourite article of food with the natives, and is now almost extinct. It was proved by Capt. Hutton to be identical with the Black Rat (*Mus rattus*), and was probably introduced by the ancestors of the Maoris. Certain species also, such as the common Brown Rat and Mouse, are now perfectly cosmopolitan in their distribution, having accompanied man in all his migrations on the surface of the globe.

The Rat and Mouse form the types of a great sub-family, Murinæ, which have the molars rooted and tuberculate when young, the infra-orbital opening high and perpendicular, widest above, and the lower root of the zygomatic maxillary process flattened into a perpendicular plate. They possess no cheek-pouches, have the fore and hind limbs approximately equal in length, the thumb rudimentary, and the tail nearly naked, covered with scaly rings. The genus *Mus*, to which our household pests belong, includes upwards of one hundred species, scattered over most parts of the Eastern Hemisphere, and living sometimes chiefly in the neighbourhood of human habitations, granaries, &c., where they often feed indifferently upon animal and vegetable substances, sometimes in the open country, and feeding

almost exclusively upon the latter. The common Brown Rat (*Mus decumanus*), sometimes called the Norway Rat, which is almost too well known to need description, is not a native of Great Britain, but was certainly introduced there by commerce, probably from some southern or eastern country—perhaps, as Pennant thinks, from the East Indies. Haunting ships in great numbers, it has now been introduced into all parts of the world, and it is quite impossible to ascertain its original habitat. It was known in Asia long before it made its appearance in Europe; and its passage into Russia is fixed by Pallas in the year 1727, when, he says, after an earthquake it swam across the Volga from the countries bordering the Caspian. Its first appearance in France and England is said to have occurred about the middle of the last century.

From its great fecundity and determined ferocity of disposition, the Brown Rat has become a great pest wherever it has taken up its abode. "It digs," says Professor Bell, "with great facility and



BLACK RAT.

vigour, making its way with rapidity beneath the floors of our houses, between the stones and bricks of walls, and often excavating the foundations of dwellings to a dangerous extent. There are many instances of their fatally undermining the most solid mason-work, or burrowing through dams which had for ages served to confine the waters of rivers and canals." It is almost impossible to keep them out of our houses, and, once in, there is no end to the mischief they do. Their ferocity is very great; and although they will, if possible, retreat from a powerful enemy, they will fight in the most savage fashion when they cannot escape.

Although not averse to a vegetable diet—as those who have to do with corn and seeds, whether in the field or the store-house, know to their cost—the Brown Rat evinces a decided preference for animal food, which he consumes of all kinds and in all states. The case of the horse slaughter-houses of Montfaucon, near Paris, is well known; here, the carcases of all the Horses killed during the day, sometimes to the number of thirty-five, would be picked to the bone by the next morning; and one main argument against the removal of the establishment to a greater distance from the city was that these swarms of ferocious vermin would be left without means of support, and would become a complete pest in the neighbourhood. That such an apprehension was not unfounded is proved by several instances recorded of the escape of Rats from wrecked ships upon small islands. In the course of

a few years they exterminated every other living thing. Professor Bell, on the authority of the late Mr. Robert Stephenson, relates the following instance of the extreme ferocity of the Rat when driven by hunger:—"In a coal-pit," he says, "in which many Horses were employed, the Rats, which fed upon the fodder provided for the Horses, had accumulated in great multitudes. It was customary in holiday times to bring to the surface the Horses and the fodder, and to close the pit for the time. On one occasion, when the holiday had extended to ten days or a fortnight, during which the Rats had been deprived of food, on re-opening the pit, the first man who descended was attacked by the starving multitude, and speedily killed and devoured." Stories are also told, with what truth we do not know, of the occurrence of similar catastrophes in the sewers of Paris and London, where, as is well known, Rats abound.

The Brown Rat breeds several times during the year, and produces as many as ten, twelve, or fourteen young ones in a litter. Its general length is about nine inches. It may be distinguished from the old English Rat, which it has displaced in most localities, by its greyish-brown colour and by the comparative shortness of its ears, which, when pressed down, do not reach the eye.

The Black Rat (*Mus rattus*), or old English Rat, as it is sometimes called, agrees closely in its habits with the Brown Rat. It is smaller than the Brown Rat, measuring only about seven inches in length, but has a comparatively much longer tail and larger ears, which, when pressed forward, cover the eyes. Its colour above is greyish or brownish-black, and the lower parts are dark ash colour. Although the Black Rat has generally been compelled to give way before its larger and more vigorous competitor, it is still widely dispersed, but not in such numbers as formerly, in Europe. Its native country was probably Southern Asia. Nearly allied to it, if indeed specifically distinct, is the Egyptian Rat (*Mus alexandrinus*). Both these Rats are said to keep more to the upper parts of houses than the Brown Rat.

Although the true Mice are very nearly allied to the Rats, of which they are copies on a small scale (and some of them, at any rate, are as destructive in their way as their larger relatives), they do not excite by any means the same sentiments of disgust with which Rats are generally regarded; ladies, indeed, will sometimes scream at the mere sight of a Mouse, but most of them will admit that, apart from its predatory habits, it is an elegant little creature. The Common Mouse (*Mus musculus*) seems to be as completely associated with man as the Rat, and has accompanied him in his wanderings to all parts of the world. It is, however, said not to occur in the Sunda Islands. Of its general appearance and habits we need say nothing; they are too familiar to need description. But besides haunting our houses, the Mouse takes up its abode in the rick-yard, and here its devastations are often very serious. The Mice live in the ricks, through which they make passages in every direction, and their fecundity is so great that several bushels of Mice are often destroyed during the removal of a single rick. The Mouse breeds all the year round, and usually produces five or six young at a birth, so that its rapid increase under favourable circumstances is easily understood. Several varieties of the species are well known, especially the Albino form, or White Mouse, which is such a favourite pet with boys. The Common Mouse in England is sometimes patched with white, and we sometimes see in the shops Pied Mice, which are said to be of Indian origin. A pale buff variety is also sometimes met with; and during the removal of a rick some years ago, it was found to be infested by a breed of Mice with a naked wrinkled skin, to which the name of Rhinoceros Mice was given at the time.

Besides these more or less domestic species, there are in Britain two other representatives of the genus *Mus*, which do not generally frequent houses. One of these is the Long-tailed Field Mouse (*Mus sylvaticus*), sometimes called the Wood Mouse, an exceedingly pretty little creature, rather larger than the Common Mouse, and having a proportionally longer tail. It measures about four inches in length, and the tail is about as long as the body; its colour is yellowish or yellowish-brown on the upper surface, whitish beneath; and the tail is brown above and white beneath. This species is found all over the temperate parts of Europe and Asia, living in the fields and gardens, where it takes up its abode, either in some small cavity under the root of a tree, in the deserted runs of the Mole, or less commonly in a little burrow excavated by its own labour. It feeds chiefly upon grain and seeds, of which it lays up a considerable store for winter use in its subterranean dwelling, and in this way does considerable damage to the crops. The Field Mouse does not, however, strictly

HARVEST MICE.

confine itself to a vegetable diet, but under circumstances of privation will attack and devour smaller and weaker animals, not even sparing its own species. It breeds more than once in the year, and produces from seven to ten young in each litter. It is easily tamed, and soon becomes familiar.

The remaining British species, the HARVEST MOUSE (*Mus minutus*), is the smallest of the British quadrupeds, with the exception of the Lesser Shrew (*Sorex pygmæus*). The Harvest Mouse is to be found in most parts of England. It also occurs in Scotland as far north as Aberdeenshire; and in Ireland, but very rarely. On the Continent its range extends over nearly the whole of Europe, from Russia in the north to Italy in the south. It is well known in Siberia, and occurs abundantly in the steppes near the Caucasus.

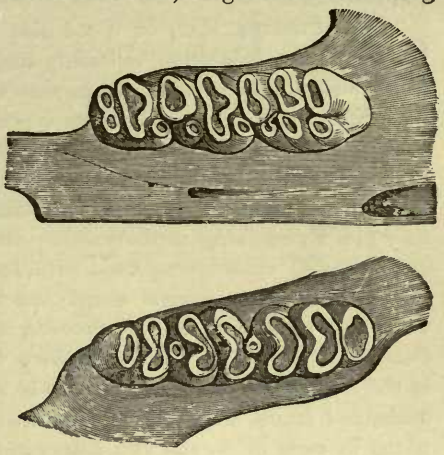
The total length of this pretty little Mouse is about five inches, of which nearly one-half is made up of the tail. In it the eyes are less prominent than in the common Field Mouse, and the ears considerably shorter in proportion. Its colour on the upper surface is bright reddish-brown, and below pure white, the two colours being sharply separated. During the summer, the Harvest Mouse associates with the other Field Mice in corn-fields, and with them is very frequently carried in the sheaves of corn to rick-yards and barns, where it then takes up its abode for the autumn and winter, and, like other Mice, multiplies very rapidly, and no doubt does a good deal of mischief. The less fortunate individuals who are left behind in the fields retreat to little burrows for protection from the inclemency of the winter, which they pass in a state of at least partial torpidity; and to provide against exigencies they lay up in their dwellings a small store of food, to which they can have recourse when a fine day recalls them for a time to activity. Those which have been introduced into ricks and barns are, of course, liberally provided for, and they show their gratitude by remaining awake all the winter, as if on purpose to consume their abundant provender. In the open field their food consists of corn and the seeds of grasses and other plants, but also to a considerable extent of small insects.

In its movements the Harvest Mouse is wonderfully agile. On the ground it runs very rapidly; and it climbs upon shrubs and plants as cleverly as a Monkey, running out upon the thinnest twigs with the greatest confidence, and climbing up stalks of grasses so thin that they bend nearly to the ground with its weight. In these operations the long slender tail comes into use, as its extremity is prehensile, and can be twisted neatly round the small stalks and branches over which the little climber is making its way. From its lively habits, and the elegance of its form, the Harvest Mouse is a very interesting pet.

The Harvest Mouse breeds several times during the year, producing from five to eight or nine young at a birth, and provides for them one of the prettiest cradles formed by any Mammal. It is placed, according to the locality, upon several grass-leaves split and interwoven with the other materials, or suspended at a height of from eighteen inches to three feet above the ground, upon the twigs of some shrub or between several stalks of corn or strong grasses. It is egg-shaped, or nearly round, about the size of the egg of a Goose, and is composed externally of slit leaves of the reeds or grasses among which it is formed, each leaf being carefully divided longitudinally by the sharp teeth of the little architect into six or eight thread-like portions, which are then all woven together, so as to produce a firm structure. The interior is lined, or rather stuffed, with all sorts of soft vegetable substances, so that it has been a question with many observers how the mother could get at all the members of her family to suckle them, and how the nest could contain them all as they began to increase in bulk. The young usually remain in the nest until they can see; but as soon as they are able to provide for themselves, the mother takes them out, gives them some practical instructions in the art of living, and then leaves them to their own devices. According to Brehm, as these Mice increase in age they improve in the art of nest-building.

Besides these few species, a multitude of Rats and Mice, belonging to the same genus, occur as natives of nearly all parts of the world, but in their habits they agree in general with the British species. India harbours a considerable number, among which we may mention the BANDICOOT RAT (*Mus bandicota*), a large species, which inhabits the Indian and Malayan peninsulas, and is very destructive in plantations; and the TREE RAT (*Mus arboreus*), a native of Bengal, seven or eight inches in length, which lives partly on grain, of which it lays up stores in its nests, and partly on young cocoa-nuts, which constitute its favourite food, and in search of which it climbs the trees. This

species builds a nest on cocoa-nut trees and bamboos, and occasionally makes predatory visits to the houses. The Striped Mouse (*Mus barbarus*) is remarkable for its coloration, its ground colour being a bright yellowish-brown or reddish-yellow, adorned with several longitudinal blackish-brown streaks. This elegant Mouse inhabits Northern Africa, especially in stony places. It is very abundant in Algeria.



MOLAR TEETH OF THE HAPALOTE.

Nearly allied to the true Mice are numerous forms more restricted in their distribution, which have been formed into distinct genera. Thus *Pelomys fallax*, in which the incisors are grooved, the tail short, and the first and fifth toes of all the feet shorter than the three middle ones, is peculiar to Mozambique; *Acanthomys*, in which the fur is mixed with flattened spines, is an African genus; whilst *Echinothrix*, which has a somewhat similar coat, is Australian. Madagascar possesses two peculiar genera, *Nesomys* and *Brachytarsomys*, the former having some relation to the American Murinæ, the latter remarkable for the shortness of the hind feet; and in Australia, besides the genus already mentioned, and one or two species of true *Mus*, we find the genus *Hapalotis* represented by about thirteen exclusively Australian species. These animals have the hind limbs rather long, the ears large, and the tail long and hairy, terminating in a tuft. The molar teeth also exhibit a peculiar pattern. The best known species is the White-footed Hapalote (*Hapalotis albipes*), an animal about the size of the Brown Rat, of a smoky brown colour, with the belly and the feet white. It inhabits New South Wales, especially in the mountainous parts. The animals of this genus were formerly regarded as allied to the South American Chinchillas and Viscachas.

The American Murines all belong to a group to which the name of Sigmodontes has been given, because their molar teeth, which in the young state have two tubercles in each transverse row (instead of three, which is the usual number in the preceding forms), when ground down by use, show some S-like patterns in the enamel folds in place of transverse ridges. The greater number of the species belong to the genus *Hesperomys* (Western Mouse), which is represented in both divisions of the American continent, and has been divided by authors into several sub-genera. The White-footed, or Deer Mouse (*Hesperomys leucopus*) is perhaps the best known of all the species, and its varieties, or rather local permanent races, are distributed all over the continent of North America. The fur shows various brownish or greyish tints above; and the lower surface, with the feet up to the wrist and ankle, is snow-white. What Dr. Coues gives as the normal colour of typical specimens is a rich fawn, with a darker streak along the back: but he says that this is shown by not more than one example in six. The tail is generally white beneath. The length of the head and body is about three inches; the tail varies considerably in length. The White-footed Mouse is nocturnal in its habits, and feeds to a great extent upon corn, of which, with acorns and other nuts, it lays up stores for winter use. It lives a good deal upon trees, taking up its abode in the deserted nest of a Squirrel or of some small bird. When it constructs its own nest the little fabric is placed in a bush at from five to fifteen feet from the ground, and is very neatly constructed, usually of fine moss and strips of bark. In some localities it burrows in the ground. The Golden or Red Mouse (*H. aureolus*), which resembles the preceding species in form and size, has the fur of the upper surface golden-cinnamon colour, and the lower parts yellowish-white. It inhabits the Central and Southern States of the North American Union. The Rice-field Mouse (*H. palustris*), which has been placed in a distinct genus (*Oryzomys*), is a larger species, sometimes attaining the size of a small Rat. This is found in the Southern States, chiefly along the coast, and in rice-fields, where it is exceedingly abundant and does considerable damage. It is eminently aquatic in its habits. The American Harvest Mouse (*Ochetodon humilis*) closely resembles the preceding species, but differs from them in a rather remarkable character. It has the upper incisor teeth grooved, a peculiarity which occurs also in the South American Rats of the genus *Reithrodon*.

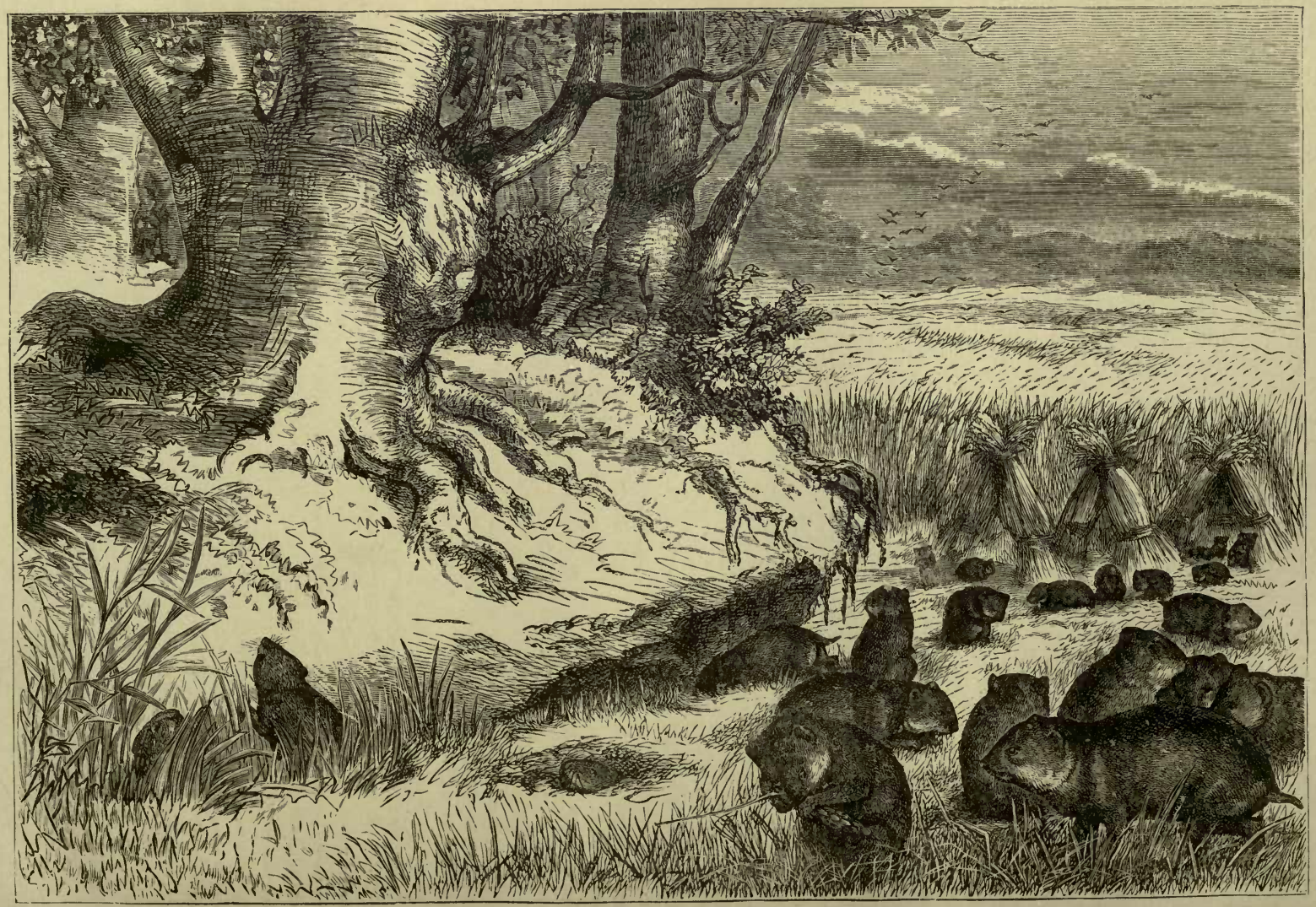
The American Harvest Mouse inhabits the Southern States, and extends northwards as far as Iowa and Nebraska.

The FLORIDA RAT, or Wood Rat (*Neotoma floridana*), is a widely distributed species in the United States, inhabiting especially the southern portion, but extending northwards as far as New York and Massachusetts. It measures from six to nine inches in length, with a tail from four to six inches long. In its coloration it presents a general resemblance to the common Brown Rat, but is brighter, especially on the sides; the lower surface is white. According to Audubon and Bachmann, the habits of this species vary considerably in different localities. These authors say that "in Florida they burrow under stones and the ruins of dilapidated buildings. In Georgia and South Carolina they prefer remaining in the woods. In some swampy situations, in the vicinity of sluggish streams, amid tangled vines interspersed with leaves and long moss, they gather a heap of dry sticks, which they pile up into a conical shape, and which, with grasses, mud, and dead leaves, mixed in by the wind and rain, form, as they proceed, a structure impervious to rain, and inaccessible to the Wild Cat, Raccoon, or Fox. At other times their nest, composed of somewhat lighter materials, is placed in the fork of a tree." This species is very active and Squirrel-like in its habits. It feeds on grain, seeds, and fruits, and sometimes makes a meal of a Crayfish or a Frog. There are from three to six young in each litter, and two litters in the year. The young animals in very early days continue to adhere to the teats of their mother, even when she is walking about outside the nest, and even at a later period they will cling to her sides and back, after the manner of some Opossums. The female seems but little inconvenienced by this burden, and shows great affection for her family, defending them even at the risk of her own life. A nearly-allied, but smaller species, the BUSHY-TAILED WOOD RAT (*N. cinerea*), inhabits the western and north-western parts of America, also extending eastward to Hudson's Bay, and southward to New Mexico and California. The COTTON RAT (*Sigmodon hispidus*), another inhabitant of the Southern States and Mexico, ranges southwards to Vera Cruz and Guatemala.

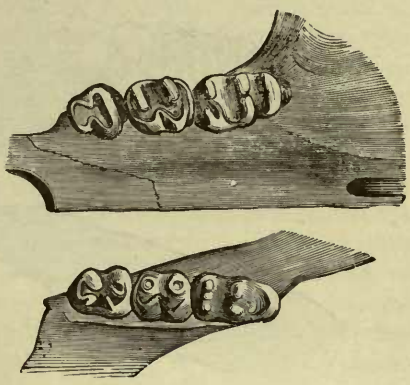
Besides several species of *Hesperomys*, South America possesses various Murine animals, which have been placed in special genera. Among these the most remarkable are those of which Mr. Waterhouse formed his genus *Reithrodon*, as these, although true Murines, have a very Rabbit-like character, and further present the peculiarity of having the upper incisors grooved. They have the profile much arched, the eyes large, the ears hairy, and the first and fifth toes of the hind feet very short. The tail is well clothed with hair. The RABBIT-LIKE REITHRODON (*R. cuniculoides*) inhabits Patagonia, where it was discovered by Mr. Darwin. It is of a yellowish-grey colour, mixed with black, with the throat and belly pale yellow, and the rump and feet white. The tail is about half the length of the head and body, dusky above, white beneath. The length of the head and body is six inches and a half. Two other species are described: one (*R. typicus*) from the La Plata; the other (*R. chinchilloides*) from the Strait of Magellan.

HEAD OF THE RABBIT-LIKE REITHRODON.

The HAMSTERS, forming the sub-family CRICETINÆ, are very nearly related to the true Mice and Rats, but differ from them at the first glance by their possession of large internal cheek-pouches, those organs being entirely wanting or very small in the Murinæ. Their molars, three in number in each series, are also tuberculate when young and regularly rooted. As age advances they become more and more worn away, so as to exhibit folds of enamel. They are stoutly-built rat-like animals, generally with short tails, with the upper lip cleft, and with short limbs, of which the hinder have five, and the anterior four, toes, the thumb being represented by a small wart. The Hamsters are confined to the Old World, and chiefly inhabit the temperate parts of Europe and Asia; two or three species occur in Africa. They live generally in corn-fields, where they dig deep burrows with numerous chambers, into which they can retreat to take their repose, and in which they pass the winter, previously, however, taking care to lay up a good store of provisions in some of the chambers of their domicile.



The best known species is the Hamster (*Cricetus frumentarius*, *see* Plate 28), a rather pretty little beast, of about ten inches long, with bright, prominent, black eyes, short, membranous ears, and a tapering hairy tail, about two inches and a half in length. The fur, which is thick and somewhat lustrous, is usually of a light yellowish-brown colour above, with the snout, the neighbourhood of the eyes, and a band on the neck reddish-brown, and a yellow spot on each cheek; the lower surface, the greater part of the legs, and a band on the forehead are black, and the feet white. Many varieties occur. This Hamster is widely distributed, ranging from the Rhine, through Europe and Siberia, to the Obi; and in most localities where it occurs it appears in great numbers, and causes great injury to the crops. Its burrows are exceedingly spacious, and consist of numerous passages and chambers. In its temper it is exceedingly irascible, and at the same time very courageous, defending itself bravely against its enemies, and standing boldly on the defensive the moment any danger appears to threaten it. Its diet is by no means of a purely vegetable nature, but it will destroy and devour all sorts of small animals that come in its way. Besides the corn, which forms its chief winter provender, green herbage, peas and beans, and roots and fruits of various kinds, are welcome articles of diet, and in confinement it will eat almost anything.



MOLAR TEETH OF THE HAMSTER.

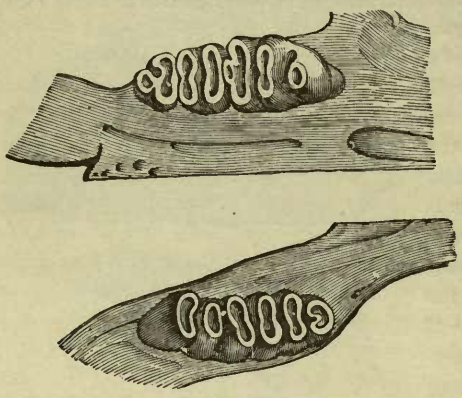
The Hamsters pass the winter in their burrows in a torpid state, but waken up very early in the spring, generally in March, but frequently in February. At first they do not open the mouths of their burrows, but remain for a time subsisting on the stores laid up during the preceding autumn. The old males make their appearance first, the females about a fortnight after them, the latter about the beginning of April. They then set about making their summer burrows, which are not so deep or so complicated as the winter dwellings; and shortly afterwards the sexes pair. The young are produced twice in the year, in May and July; their number varies from six to eighteen. They have teeth when first born, and their development as babies is very rapid. Their eyes open in little more than a week after birth, and in another week they begin to burrow in the ground, and then their hard-hearted parent drives them off to take care of themselves.

The other species of this sub-family generally very closely resemble the Hamster, both in appearance and manners. Most of them are found in Central Asia and Siberia, extending southwards as far as Persia and South Tartary. *Cricetus songarus* has been obtained at Kumaon. The recorded African species belong to two peculiar genera: they are *Saccostomus lapidarius* and *fuscus*, and *Cricetomys gambianus*.

Other African forms constitute the small sub-family of the Tree Mice (*Dendromyinæ*), which are entirely confined to the southern portion of the continent. They are characterised by having the incisors rounded and grooved in front, the infra-orbital opening not narrow below, and the coronoid process of the lower jaw very small. The ears are clothed with hairs; and the feet, which are five-toed, are furnished with long claws, which are serviceable to the little rat-like animals in climbing up the trunks of trees. The Black-streaked Tree Mouse (*Dendromys mesomelas*) is a rather pretty little species, of a greyish colour, with a black line down the middle of the back. It is slender in form, with a long, scaly tail, rounded ears, and the two outer toes in each foot shorter than the rest. *Steatomys pratensis*, from Mozambique, is stouter in form than the preceding, and has a short, densely hairy tail; and in *Lophuromys ater*, from the same locality, the incisors are not grooved, and the fur is developed into fine flattened bristles.

The Gerbilles (*Gerbillinæ*) are distinguished from all other Muridæ (although approached by *Hapalotis*) by the great length of the hind limbs, which are converted into powerful leaping organs, somewhat as in the Jerboas and Kangaroos, although not quite to the same extent. Like all the preceding forms, they have the molars furnished with roots, but not with tuberculate crowns, these being divided into transverse plates formed by separate elliptical or rhomboidal coats of enamel. The incisor teeth are narrow, the infra-orbital opening as in the Murinæ, and the tail long and hairy.

The Gerbilles are plump little animals, with a short neck, a broad head, and a pointed muzzle. The feet are five-toed, but the thumb on the fore feet is reduced to a mere wart-like process with a flat nail. They are confined to the Eastern hemisphere, and, indeed, to the African continent, the south of Asia, as far as India, and the south-east of Europe, where they live both in cultivated districts and in the driest deserts, and often occur in great numbers, when they may cause considerable damage to the neighbouring crops. They shelter themselves during the day in shallow burrows, and come forth in the evening in search of their food, which consists chiefly of grain and roots. They store up great quantities of the ears of corn in their subterranean dwellings, and in many places the poorer inhabitants search after these stores, and by digging them out procure a good supply of grain. They are very prolific, the females producing large families several times in the year.



MOLAR TEETH OF THE GERBILLE.

Several other forms of Muridæ, with rooted molars, have been distinguished, and all are inhabitants of the Eastern hemisphere. The genera *Phlœomys* and *Nesokia*, each including a single species, form the group PHLÆOMYINÆ, characterised by having broad incisors and the molars divided by transverse plates of enamel. The characters of the skull are as in the Murinæ. *Phlœomys Cumingii* is from the Philippine Islands; *Nesokia Griffithii* inhabits Northern India. *Platacanthomys lasiurus*, the only known species of the group PLATACANTHOMYINÆ, resembles a Dormouse in its form, and is nearly allied to the preceding species, but has the fur of its back mixed with long, flattened, bristle-like spines. It is a native of the Malabar coast.

The WATER MICE (*Hydromyinæ*) are of particular interest, as being a small group, exclusively confined to the Australian region, and presenting the exceptional character among the Rodents of having only two molars on each side in each jaw. These teeth, are rooted, and divided into transverse lobes by ovate enamel lobes; the front tooth is much larger than its fellow. The *Hydromys* are small rat-like animals of slender form, with long tails, rather densely clothed with short hairs, and short limbs. The hind feet have much stronger claws than the fore feet, and their toes are partially webbed. Five species of this group are known from Australia and Van Diemen's Land, where they inhabit the banks of the streams. The best known are the Yellow-bellied and the White-bellied Water Mice (*Hydromys chrysogaster* and *leucogaster*), both of which inhabit New South Wales, and the latter is also found in Van Diemen's Land. The Sooty Water Mouse (*H. fuliginosus*) is an inhabitant of Western Australia.

SKULL OF THE WATER-MOUSE.

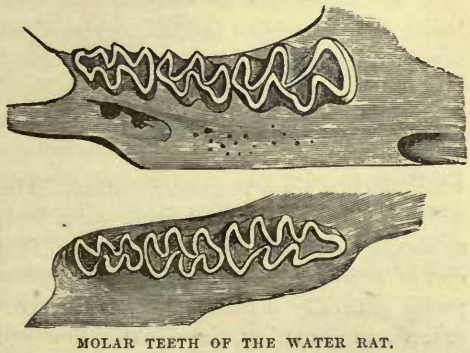
In the SMINTHINÆ—a group which includes only the genus *Sminthus*, founded for the reception of a rat-like Rodent (*S. vagus*) first discovered in the Crimea, but now known to range from Hungary, Finland, and Sweden, through Russia to the banks of the Irtisch and Yenisei, and into Tartary (Bokhara)—we find another exceptional character of the molar teeth. There are four of these teeth on each side both above and below, the first and fourth of which are much smaller than the intervening ones. In this animal the ears are rather long and pointed, the legs are rather short, and the tail is about as long as the body, and clothed with short hairs.

TEETH OF SMINTHUS.

In the remainder of the Muridæ, the molars, which are again only three in number on each side, are generally rootless, although occasionally the growth of the teeth stops and they close up below. The molars are composed of triangular prisms placed alternately. Two groups are thus characterised, namely, the Voles and the Zokors.

The Voles (*Arvicolinæ*), which, next to the true Rats and Mice, form the most important group of Muridæ, are represented in the northern parts of both hemispheres. The brain-case in these animals is rhomboidal when looked at from above, the frontal region of the skull is much contracted, and the zygomatic arch stands out very far. The infra-orbital opening is as in the Murinæ. The molars are so constructed of alternating triangular prisms that the whole margin is enclosed by deep angular folds of enamel. These are mouse- and rat-like Rodents of a rather stout build, with the limbs and tail of moderate length, or short, and the latter more hairy than in the true Murines. The ears are short, often nearly concealed beneath the fur.

The true Voles (genus *Arvicola*) number about fifty known species, which have been arranged by various writers under a considerable number of sub-genera, generally corresponding to differences in mode of life. Three species, representing three of these groups, are found in Britain, and may serve to illustrate the natural history of the Voles. The largest of these is the well-known Water Vole, or Water Rat, as it is more commonly called (*Arvicola amphibius*), an animal rather smaller than the Common Rat, and having, like all the Voles, the muzzle considerably blunter, and the tail a good deal shorter and more hairy. Although thoroughly aquatic in its habits, the feet of the Water Vole are not webbed; they have five toes, but the thumb in the fore feet is very short. The general colour of the fur is reddish-brown, mixed with grey on the upper surface, and yellowish-grey beneath; the ears are nearly concealed in the fur; and the incisor teeth are deep yellow in front, and very strong, presenting a considerable resemblance to those of the Beaver, to which great Rodent the Voles were formerly considered to be related. It is very widely distributed, being found in all parts of Europe, and stretching right across Central and Northern Asia, to China, the Amoor region, and the Sea of Okhotsk. In Ireland, however, it is not found. Its habits vary a little in different localities, but in general it haunts the banks of rivers, in which it burrows to a considerable distance. In the water it is very active, swimming and diving with the greatest facility, and it is here that it seeks its food, which appears to consist exclusively of vegetable substances. Professor Bell says:—"A decided preference is shown, during the summer months, for the inner or concealed part of some species of sword-flags, which is very succulent and sweet-tasted. As this portion is usually below water, the animal gnaws the plant in two near its root, when it rises to the surface, and being conveyed to some sound footing, is consumed at leisure. In default of its more favourite food, it will make a satisfactory meal on the common duckweed. Only the green and fleshy leaf is eaten, the roots and other fibrous parts being rejected. While feeding on this plant, the creature sits like a Squirrel on its haunches near the water's edge, and taking up a lump of the soft and slimy-looking mass in its fore paws, eats a small part only, and letting the remainder fall, takes up some more in the same manner." The accusation sometimes brought against the Water Vole of eating worms and insects, and even of destroying fish-spawn, young fishes, and even young ducks, seems to be entirely unfounded. In the winter the Water Voles will feed on turnips, mangel-wurzel, and other roots, and also upon the bark of osiers and willows, to which they do considerable damage; and in some localities they appear to frequent gardens at all seasons of the year, burrowing in the ground, and feeding luxuriously upon the produce of the gardener's labour. Their greatest activity is in the twilight, but in quiet situations they are to be seen abroad during the day. The female produces from two to six young at a litter: twice in the year in Britain, according to Professor Bell; three or four times in the course of the summer, according to Brehm and other Continental naturalists.



MOLAR TEETH OF THE WATER RAT.

A second British species is the Field Vole, or Short-tailed Field Mouse (*Arvicola agrestis*), which is less than half the size of the Water Vole, and has the tail only about one-third the length of the body, instead of half that length. In the general form of the head and body the two species are a good deal alike, but the ears project farther beyond the fur in the Field Vole. The general colour of this species is greyish-brown, becoming tinged with reddish or yellowish on the sides; the

lower surface is pale grey or dirty white, and the tail is brown above and greyish beneath. The Field Vole is a very abundant species in the northern and central parts of Europe, but is wanting in Ireland and south of the Alps and Pyrenees. It is usually found in damp places, especially in meadows in the neighbourhood of woods and copses, where it forms burrows of considerable extent. Its food consists almost exclusively of vegetable substances, such as roots and herbage, and in times of scarcity it will climb up trees and bushes to feed on the tender parts of the bark. In case of necessity, however, it does not disdain animal food, but will eat insects and meat, and even sometimes kill and devour smaller individuals of its own species. It breeds three or four times in the year, producing from four to six young at a birth, in a small round nest made of moss and leaves, among the roots of the herbage in some hollow of the ground. Their increase, which would otherwise be very formidable, is checked by the smaller predaceous beasts and birds, such as the Weasel, the Kestrel, and the Owls,

SOUTHERN FIELD VOLE.

which destroy them in great numbers. The BANK VOLE (*Arvicola glareolus**), the third British species, which is chestnut-coloured, with white feet and with a longish tail, closely resembles the preceding species in its habits, but feeds rather on fruits and roots than on herbage, and is far more addicted to a diet of animal food, freely devouring insects, worms, snails, and even young birds and carrion. It is pretty generally distributed over Europe, but not so uniformly as the Field Vole, which it even exceeds in fecundity, the females producing from four to eight young three or four times in the year, in a nest constructed of grass and moss placed in a hollow of the surface of the ground among dense herbage.

The Continent of Europe is inhabited by several other species of Voles, among which we may notice the little SOUTHERN FIELD VOLE (*Arvicola arvalis*), which more or less completely takes the place of our common Field Vole in Southern Europe, but also extends over the whole of Central Europe, and into Western Asia. Several of these species, and others to which we cannot specially refer, ascend to considerable elevations on the mountain-sides, but at least one species,

* See *Arvicola rutilus*, p. 117.

the Snow Mouse (*Arvicola nivalis*), lives on the Alps and Pyrenees, at elevations of 4,000 feet and upwards, being most abundant about the limit of perpetual snow, where it not only resides during the short period of summer, when some portion of the surface is freed from its snowy covering, but actually throughout the winter, buried under the snow, through which it makes its way in search of the roots of plants. The Root Vole (*Arvicola œconomus*) is a large and abundant Siberian species, the range of which extends from the Obi to Kamstchatka. This and some other northern species often migrate in great bodies, after the fashion to which we shall have to refer when speaking of the Lemmings.

In North America, it would appear from Dr. Coues' monograph, there are about a dozen distinct species of Voles. One of them, confined to the northern parts of the Continent, he identifies with the *Arvicola rutilus* of the Old World, which he regards as a circumpolar species. South of a line running from sea to sea, a little north of the boundary of the United States, comes another form, *A. Gapperi*, which is regarded as a sub-species of *A. rutilus*, to which *A. glareolus* (*see* p. 116) is considered to stand in a similar relation. The most abundant North American species is the Meadow Mouse (*A. riparius*), which is distributed, apparently, over the greater part of the Continent, and takes the place of the Field Vole. On the prairies there is a peculiar species (*A. austerus*), a sub-species of which (*A. curtatus*) is found in the Western territories as far as California; the Pine Mouse (*A. pinetorum*) inhabits the country east of the Mississippi; and the genus is represented in Mexico by one species (*A. quasiater*). The Voles are most numerous and abundant in the northern and north-western parts of North America.

Another American species is the Musquash, Musk-Rat, or Ondatra (*Fiber zibethicus*), which constitutes a genus distinguished from the true Voles by having the tail compressed and nearly naked, the hinder toes united by short webs, and fringed with long hairs, and the enamel folds of the molars united by a line running down the middle of the tooth. The form of the animal is thickset, and in this respect, as in its aquatic habits, it resembles the Beaver, to which it was formerly supposed to be nearly allied. The head is short and broad, the ears project very little beyond the fur, the hind limbs are longer than the fore legs, and terminate in five toes with strong claws, while the fore limbs have only four toes and a wart-like thumb; the fur is very thick and shiny, and the colour is usually brown above and grey below, with the tail, which is nearly as long as the body, black. The fur is well known in commerce. The length of the head and body of a full-grown male is about twelve inches. The name Musk-rat, often given to this species, refers to the musky odour diffused by the secretion of a large gland situated in the inguinal region.

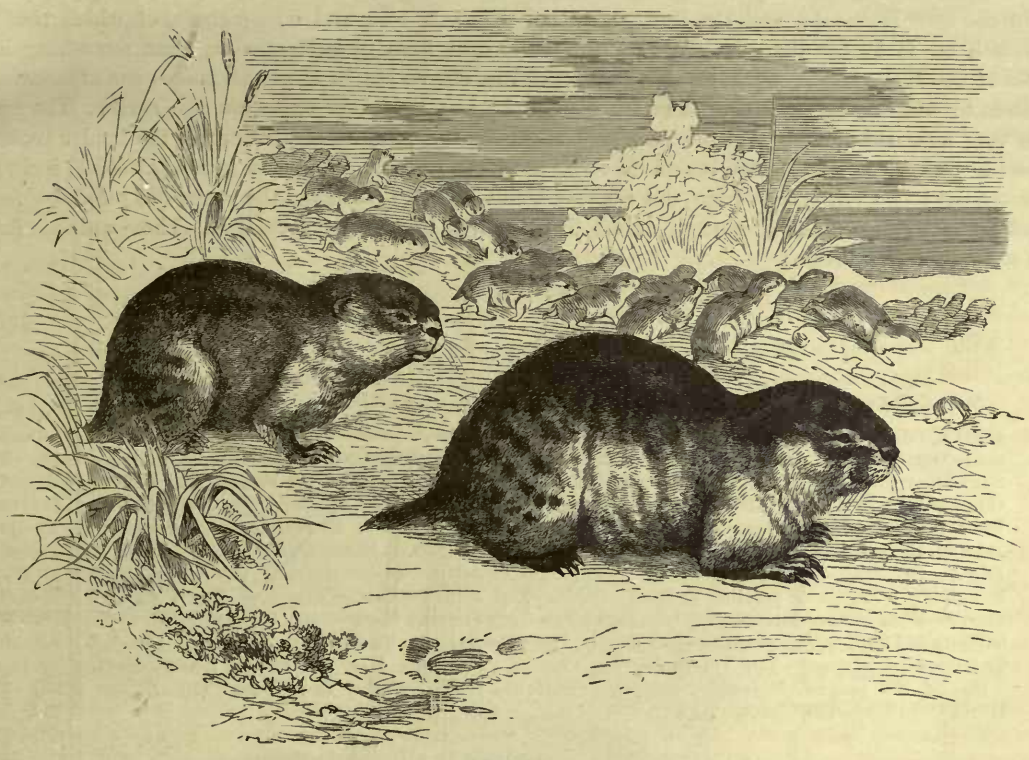
The Musquash, which may be described as a large Water Rat, inhabits all the suitable parts of North America, from the thirteenth to the sixty-ninth degree of north latitude, and is most abundant in the Canadian region, which offers it peculiarly favourable conditions of life in the multitude of rivers and lakes, upon the banks of which the Musquash always takes up its abode. It is a nocturnal animal, passing the day in concealment, and coming forth with the twilight to seek its nourishment, and amuse itself with its fellows. In the water it displays wonderful activity, and, in many respects, presents much resemblance to the Beaver. Curiously enough, the parallelism of habits holds good to a certain extent, even in the construction of their dwellings. The Musquash generally lives in a burrow dug out of the bank of the stream in which he disports himself, and consisting of a chamber with numerous passages, all of which open under the surface of the water. But, under certain conditions, especially in the north, he builds himself a house of a rounded or dome-like form, composed of sedges, grasses, and similar materials, plastered together with mud, and supported upon a mound of mud of sufficient height to raise it above the water. The house contains a single chamber from sixteen inches to two feet in diameter, and is entered by a passage which opens at the bottom of the water. Other passages are said to issue from this, and to lead down into the ground under the bottom of the water; these are made by the animal in his search for the roots of water-lilies and other aquatic plants, which constitute a great part of his nourishment. The Musquash also seeks provisions on land, and in this way often does much mischief in gardens. Fresh-water mussels also form a part of its diet. It passes the winter in its house, which it then furnishes with a soft bed of leaves, grasses, and sedges, and, according to Audubon, ventilates by covering the middle of the dome only with a layer of similar materials, through which the air can pass. Of the propagation of the Musquash very little seems to

MUSQUASH.

be known with certainty. They pair in April and May, and the female produces from three to six young at a birth; but whether this takes place once or several times in the course of the summer is a matter of doubt. They are captured in fall-traps baited with apples, or by traps set at the mouth of their burrows. The Indians sometimes spear them in their houses.

The Lemming (*Myodes lemmus*) is one of the most remarkable of the Muridæ, on account of the great migrations which it performs, apparently with no special object. In Norway, where it is best known, they make their appearance in the cultivated districts in such enormous numbers, and so suddenly, that the peasants have always believed them to fall from the clouds. The Lemming is a Vole-like animal, about six inches long, of which the tail makes up about half an inch. It varies considerably in colour, but is usually brownish-yellow, with dark spots above, and with a yellow streak enclosing the eye on each side of the face; the under surface is yellowish. The ears are very short, scarcely projecting beyond the fur; the eyes are small, black, and bead-like; the soles of the feet are hairy, and the claws of the fore feet much stronger than those on the hinder extremities. The Norwegian Lemmings live and breed among the peat mosses of the mountains. They are lively and active little creatures both by day and night, and feed upon the scanty vegetation of their Alpine home—grasses, lichens, the catkins of the dwarf birch, and roots. They are active even through the winter, when they make passages for themselves under the thick covering of snow which then veils the whole country, and thus are enabled to go in search of their ordinary food. They also make their way up to the surface, upon which they may occasionally be seen running, even in the depth of winter. They breed in their burrows and under stones, and must be very prolific, seeing that every predaceous animal in the country destroys and devours them. The Lemming is, in one sense, an exceedingly timid little creature, the slightest disturbance of its quietude, or even the passing over-head of a cloud, being sufficient to alarm it; but when attacked it displays the

most dauntless courage, standing on the defensive against both men and animals, and biting very sharply at anything that comes within its reach. From time to time, from some unexplained cause, the Lemmings start in vast swarms from their mountain fastnesses, and make their way in a straight line in some definite direction. Nothing seems to turn them from their course; they go straight on, over hill and dale, and, although said at other times to have an aversion to water, they now swim across any lakes or rivers that come in their way. In this operation many of them lose their lives, for they require smooth water for their navigation, and the least breeze ruffling the surface suffices to send hundreds of them to the bottom. In this way they gradually arrive at the cultivated regions, where they do so much damage to vegetation, that in olden times a special form of prayer and exorcism was in use against them. Their march is



LEMMING.

accompanied by great numbers of carnivorous beasts and birds of all sorts. Wolves, Foxes, and Wild Cats, and the smaller quadrupeds of the family Mustelidæ, Eagles, Hawks, and Owls, all prey upon them with avidity—even the Reindeer is said to stamp them to death; and the story of his eating them, long discredited, has been confirmed on good authority, while man, with his Dogs and Cats, is not behindhand in the work of destruction. Nevertheless, a great multitude survives all these dangers, and, strange to say, the termination of this painful migration is always the sea, into which the survivors of the march plunge, and, apparently, voluntarily commit suicide. Mr. Crotch, who has published several papers on the Lemming and its migrations, says that in Norway these animals always proceed from the central backbone of the country in an east or west direction, and that in either case the survivors of the march drown themselves, those that go westward in the Atlantic, those that go eastward in the Gulf of Bothnia. His notion is that the migration is in obedience to an inherited instinct acquired at a time when there was land where the sea now rolls; but there are many difficulties in the way of such a hypothesis.

Besides the Scandinavian Lemming above noticed, several other species occur in the northern parts of the world. Three species (*Myodes lagurus*, *obensis*, and *torquatus*) inhabit Siberia; the latter

two are found in North America, the last also in Greenland. In this species, which has been placed in a distinct genus under the name of *Cuniculus torquatus*, the third and fourth toes of the fore feet are much larger than the second and fifth (the thumb being rudimentary), and their claws become periodically enlarged to double their ordinary size by an enormous growth during winter of horny matter on the lower surface.

The transition from this to the next family is effected by two genera, which to such an extent combine the characters of the two as to have led different zoologists to place them sometimes in the one, sometimes in the other. Externally they have all the characters of the Mole-rats of the following family; in the characters of the skull and teeth they more resemble the Voles. The Zokor (*Siphneus aspalax*), which may be taken as an example of these forms, is an inhabitant of the Altai Mountains, has the eyes very small, the external ears reduced to mere rudiments, the body cylindrical, as in the true Mole-rats, and the fore-feet armed with very long and strong claws, of which that on the fifth toe is longer than the toe itself. This animal lives in subterranean runs something like those of the Mole, but of much greater extent, and in burrowing in the earth makes use of its strong incisors to cut through the roots it meets with, and when necessary to loosen the earth. The runs pass very near the surface, and are no doubt made for the purpose of feeding on the tender roots of grasses. A species of *Siphneus* is said to occur in North China. The other genus (*Ellobius*) includes two species; one (*E. luteus*) from the country about the Sea of Aral; the other (*E. talpinus*) from south-eastern Russia and the west of Asia. The latter abounds in the Crimea. These animals form the sub-family Siphneinæ.

CHAPTER III.

MOLE RATS, POUCHED RATS, POUCHED MICE, JERBOAS, AND OCTODONTIDÆ.

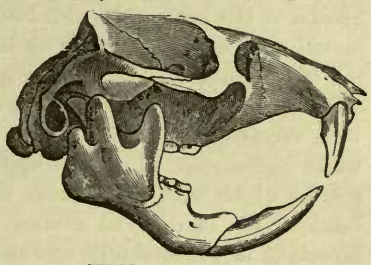
SPALACIDÆ, OR MOLE RATS—Characteristics of the Family—Habits—Food—The Mole Rat—Distribution—Description—The Chestnut Mole Rat—The Naked Mole Rat—The Strand Mole Rat—Description—Habits—The Cape Mole Rat—GEOMYIDÆ, OR POUCHED RATS—Characteristics of the Family—The Cheek-pouches—The Common Pocket Gopher—Distribution—Description—Burrowing—Runs—Subterranean Dwelling—The Northern Pocket Gopher — Heteromyinæ, or Pouched Mice — Difficulties as to Position — Characteristics — Phillips' Pocket Mouse—Where Found—Description—The Yellow Pocket Mouse—The Least Pocket Mouse—DIPODIDÆ, OR JERBOAS—Organisation for Jumping—Characteristics—Distribution—The American Jumping Mouse Description—Characters peculiar to Itself—Habits—The True Jerboas—Characters—The Jerboa—Distribution—Habits—Mode of Locomotion—The Alactaga—The Cape Jumping Hare—THE PORCUPINE-LIKE RODENTS—OCTODONTIDÆ—Characteristics—Sub-Family, Ctenodactylinæ—The Gundi—The Degu—Description—Habits—The Brown Schizodon—The Tukotuko—The Cururo—The Rock Rat—Sub-Family, Echinomyinæ—The Coypu—One of the Largest Rodents—Description—Burrows—Habits—Mother and Young—The Hutia Conga—The Hutia Carabali—The Ground Rat.

FAMILY VIII.—SPALACIDÆ (MOLE RATS).

Although the Zokor and its allies in the preceding family have to a certain extent prepared us for the peculiar characters presented by the Mole-rats, these are exhibited by the latter in a much more extreme form. They have a very large broad head, which is usually flattened above, and forms an appropriate anterior termination to a clumsy, cylindrical body, supported upon short stout limbs; their incisor teeth are large and broad, and are most formidably exposed in front of the mouth; their eyes are exceedingly small, hidden in the fur, and sometimes quite rudimentary; the external ears are reduced to the smallest possible size, or altogether wanting; and their tails are either so short as to be concealed within the hair of the hinder part of the body, or altogether wanting externally, although the skeleton still shows some caudal vertebræ. The molar teeth are rooted, and not tuberculate; their surface shows re-entering folds of enamel. The feet have five toes, but the thumb is generally very small, although furnished with a nail. The number of molars varies from three to six on each side in each jaw.

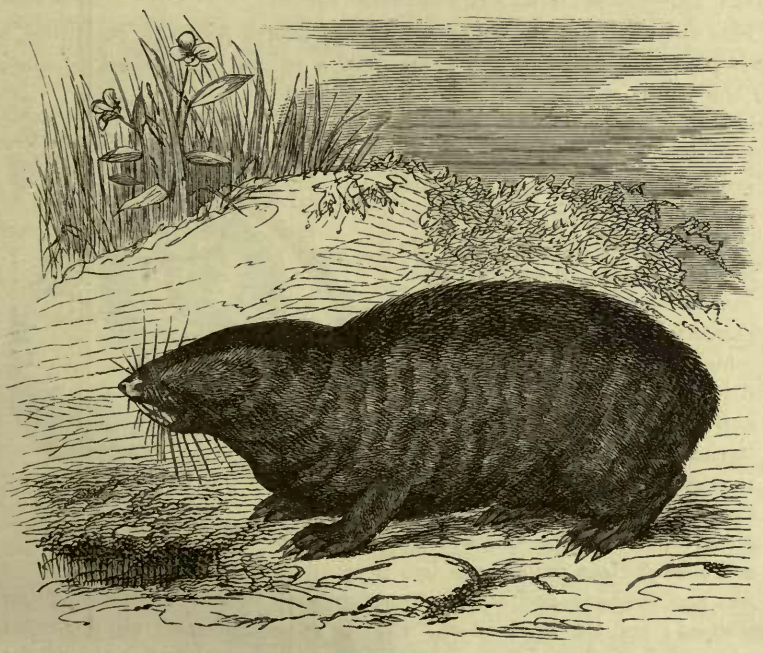
In their mode of life, as in their form and the condition of the organs of sight and hearing, these animals present a considerable resemblance to the Moles; but as their food is exclusively of a vegetable nature, the object of their burrowing is not exactly the same. They all inhabit the eastern hemisphere, and are generally met with in dry sandy plains, the soil of which lends itself readily to

mining operations. They seldom quit their burrows, and usually work in these only at night, when they make their way rapidly through the ground, and, like the Mole, can run either backwards or forwards in their subterranean galleries with equal facility. They feed chiefly on roots, and especially on the bulbs and tubers which so many plants possess in the dry districts which they frequent; but some of them also eat nuts, seeds, the young bark of trees, and herbage. None of them fall into a state of torpidity during the winter—indeed, only two species inhabit northern regions; but these, although active in the winter season, are said not to take the precaution to lay up a store of provisions.



SKULL OF MOLE-RAT.

Most zoologists distinguish two groups of Spalacidæ. In the SPALACINÆ, the representatives of which range from south-eastern Europe to further India and the south of China, and also occur in Africa in the countries of Abyssinia and Shoa, the palate between the molar teeth is broader than one of the sockets of the molars, and the angular portion of the lower jaw springs from the lower edge of the bony case of the incisor. To this group belongs the MOLE-RAT (*Spalax typhlus*), which inhabits Hungary and Galicia, and the south-east of Europe generally, and ranges eastwards into Asia as far as the Caucasus and Ekaterinoslav. It possesses only three molars on each side in each jaw, and has the eyes rudimentary and covered by the skin, so that the animal is quite blind; the upper incisors are placed perpendicularly; and the tail reduced to a sort of wart. The toes, especially those of the fore-feet, are furnished with very powerful claws, which are vigorously employed by the animal in the digging operations above described. The general covering of the body is a soft fur of a yellowish-brown colour, tinged with ashy-grey; the head lighter, but becoming brownish behind; and the lower surface ashy-grey, with some white streaks and spots. The muzzle, chin, and feet are whitish, and along each side of the face there runs a sort of ridge of stiff bristle-like hairs. This species is particularly abundant in the Ukraine and the country about the Volga and the Don.



MOLE-RAT.

The genus *Rhizomys*, of which there are an East Indian and two African species known, has the eyes uncovered, though very small, short naked ears, and a short partially hairy tail. The upper incisors are arched forward. The CHESTNUT MOLE-RAT (*Rhizomys badius*) lives in Northern India, Siam, and Arracan; and, according to Mr. Finlayson, the food of a specimen in confinement consisted of unhusked rice and other grain, but he showed himself fond of yams and pumpkins. The NAKED MOLE-RAT (*Heterocephalus glaber*), which has no external ears and a short tail, has the body almost entirely naked. It is a native of Shoa.

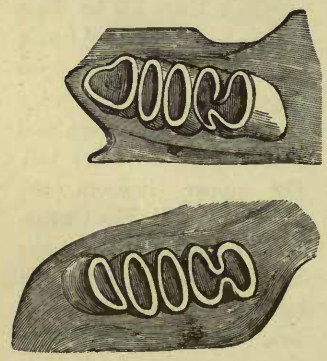
The other section of the Mole rat family, the BATHYERGINÆ, is entirely confined to Africa, and, indeed, almost exclusively to the southern extremity of that continent, only a single species being

found elsewhere—at Mozambique. They show a resemblance to the Hystricine Rodents in the structure of the lower jaw, the angular portion of which springs from the side of the bony case of the lower incisor; and the palate between the molars is narrower than in the Spalacinæ. The best known of the six species inhabiting the Cape of Good Hope is the STRAND MOLE-RAT (*Bathyergus maritimus*), which is nearly as large as a small Rabbit, its length being about ten inches, with a tail two inches in length. In general form it resembles the species last described; it has small but uncovered eyes, a broad nose, no external ears; very long, compressed, and powerful claws on all the toes, except the thumb of the fore-feet, which has a crooked nail; four molars on each side, and long white incisors, of which the upper ones are strongly grooved in front. The colour of the fur is greyish-white, with a yellowish tint on the upper surface. The tail has a sort of radiating tuft of hairs at the end. The Strand Mole-rat lives entirely in sandy localities near the sea-shore, and especially in the sand-hills or dunes which fringe the coast of the Cape of Good Hope in some parts. Here it burrows freely in all directions, its galleries generally radiating from several central points, and joining in various places. It avoids the light as much as possible, and if by chance it is exposed on the surface it is exceedingly helpless. Very little is known of the habits of this species, which probably feeds chiefly on roots like the other members of the family. It is regarded as mischievous, as it undermines the ground so much as to make it unsafe to ride over. The colonists, therefore, often destroy it by various means. The enamel folds of the teeth become effaced with use.

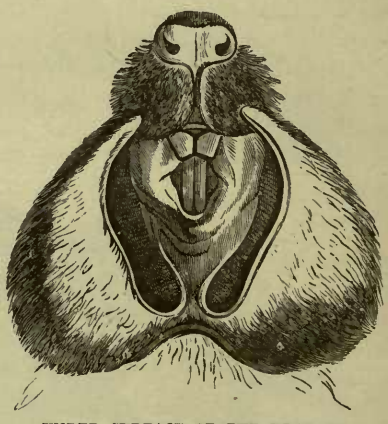
The *Georychi*, five species of which inhabit Cape Colony, resemble the preceding species, but are smaller and weaker. The claws of the fore-feet are shorter and weaker, and the upper incisors, which are long and arched forward, are not grooved. The best-known species is the so-called CAPE MOLE-RAT (*Georychus capensis*). In the Mozambique species (*Heliophobius argenteo-cinereus*) there are six molars on each side above and below, and the second toe of the hind feet is the longest. In most other characters it resembles *Georychus*.

FAMILY IX.—GEOMYIDÆ, OR POUCHED RATS.

The Pouched Rats, or Pocket Gophers, and the Pouched Mice of North America, constitute a family distinguished from all the preceding forms by the presence of a pair of great cheek-pouches, opening *outside* and not inside the mouth (*see* figure). These cheek-pouches are hairy inside throughout. The angular portion of the lower jaw is strongly twisted, the molars are four in number on each side in each jaw, and the squamosal bone is very large. In external characters the animals of this family present considerable diversity, which has led to their being divided into two well-marked sub-families, the distinctive peculiarities of which are of such importance that Dr. Coues has raised them to the rank of distinct families. The GEOMYINÆ, or Pouched Rats, are more or less Rat-like animals, in which the feet are five-toed, and all the toes furnished with claws, those of the fore feet being very strongly developed; and the tail is short. Certain other characters are presented by the skull. The outline of this part, including the zygomatic arches, is almost quadrangular; the infra-orbital opening is far in front of the jugal process; the malar bone extends forward to the lachrymal.



MOLAR TEETH OF THE MEXICAN POUCHED RAT.

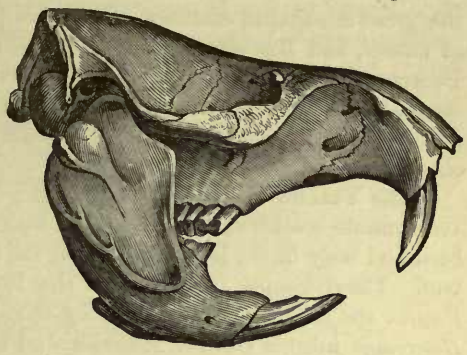


UNDER SURFACE OF THE HEAD OF HETEROMYS.

Of the animals thus characterised, the Continent of North America possesses, according to Dr. Coues, seven species, and they are met with from Hudson's Bay and the Columbia River in the north, as far south as Mexico. The best-known species, the COMMON POCKET GOPHER (*Geomys*

bursarius), inhabits the whole valley of the Mississippi, and extends northwards into Canada. It reaches the foot of the Rocky Mountains in Colorado, but is not known to occur west of that range. It is also found in Texas. This Pouched Rat, like the rest of its genus, has the incisors broad and the upper ones deeply grooved; but in addition to the ordinary deep groove it has a fine line close to the inner margin of each of these teeth. Its form is stout and clumsy, but its coat is beautifully soft and velvety, like that of the Mole, but of a dull reddish-brown colour, with the feet and tail white. The average length of an adult specimen is from seven to eight inches, and the tail is two or three inches long. This organ is clothed with hair nearly to the tip.

Like the Mole, this animal lives in burrows, which it makes in all directions in the ground, throwing out as it proceeds heaps of earth, which exactly resemble ordinary mole-hills. To enable it to perform these labours the claws of the fore feet are exceedingly powerful; and to adapt it the better to its subterranean existence, the eyes are very small, and the external ears are wanting. Its digging operations have generally the same object as those of the Mole—namely, the search for food. The tunnel is carried along not far from the surface of the ground, and the roots of any plants that lie in its course are bitten off and devoured by the little miner. Besides the runs, the Pouched Rat digs himself a convenient dwelling in the shape of a chamber hollowed out under the roots of a tree, access to which is gained by a somewhat spiral descending passage. This chamber, which is usually at a depth of four or five feet, is comfortably lined with soft grass, and the nest in which the female brings forth her young is a cavity of the same kind, but surrounded by circular passages, from which, like that of the Mole, other passages branch off. One of these, according to Gesner, leads from the nest to a large store-chamber filled with nuts, seeds, and roots, among which the potato was found to play an important part. These provisions are carried to the store-house in the great cheek-pouches, which the animal is said to fill by the aid of its tongue, and to empty with the fore paws. This Pouched Rat does much damage in cultivated ground by attacking the roots of both plants and trees, sometimes destroying a great number of the latter in a few days. The female produces from five to seven young at the end of March or the beginning of April. The other species of *Geomys* closely resemble this in their habits.



SKULL OF THE MEXICAN POUCHED RAT.

Of the second genus belonging to this sub-family (*Thomomys*) Dr. Coues admits only two species, one of which, however, occurs under three named forms. They may be distinguished from the species of *Geomys* by their having the upper incisors plain, without grooves.

The Northern Pocket Gopher (*Thomomys talpoides*), with its sub-species, ranges over nearly the whole of North America from the Hudson's Bay Territory to California and New Mexico. The three forms are for the most part in accordance with geographical distribution. A small species (*Thomomys clusius*) has been obtained in the Rocky Mountains.

The Heteromyinæ (forming the family Saccomyidæ of Dr. Coues, although he does not accept the genus *Saccomys*) are more slender and delicate in form than the Geomyinæ, and have the hind limbs and tail elongated, the former, indeed, being converted into leaping organs like those of the Jerboas and Kangaroos. The eyes and ears are larger, and the animals are in every respect adapted to life in the open, while the Geomyinæ, on the contrary, are subterranean in their habits. The hair in the present family is coarse and harsh, sometimes even spiny. In skeletal characters we find a similar alteration. The incisors are narrow; the skull is delicate, with its angles rounded off, and the mastoid bones form a considerable part of the roof of the cranial cavity; the zygomatic arches are slender; and, the lower root of the maxillary process being undeveloped, the infra-orbital opening is not defined. As in the Jerboas, the cervical vertebræ are sometimes anchylosed. Like the Geomyinæ, these animals are confined to America, and chiefly limited to the Southern United States and Central America, although some of the species occur as far north as the Columbia

River and Hudson's Bay, and one is found in Trinidad. By American writers they are called "Pocket Mice."

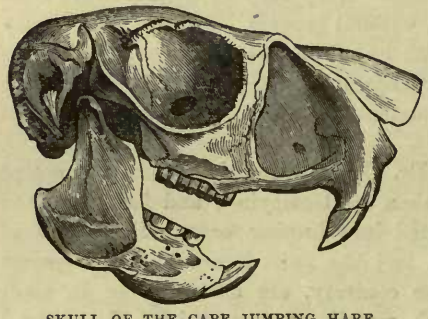
Phillips's Pocket Mouse, also known as the Kangaroo Rat (*Dipodomys Phillipsii*), is one of the best known species of this group. It is an elegantly formed little creature, about four inches long, with a slender tail nearly six inches in length. Its colour above is mouse-brown, white beneath; the sides of the body have some white streaks, especially one from the ear towards the shoulder, and one on the thigh running towards the root of the tail; the tip of the tail is also white. This is a Californian species, but extends throughout the Pacific region of the United States. It is represented in the Rocky Mountains by a rather larger and stouter form, with smaller ears and a shorter tail (*Dipodomys Ordii*), which is generally regarded as distinct, but is placed by Dr. Coues as a subspecies. The habits of the species are comparatively little known, but they appear to live in the most desert places they can find, the barren spots on which the only plants that seem to flourish are the great mis-shapen cactuses. They dwell in holes under rocks and stones, from which they emerge at sunset, and hop about gaily after the fashion of little Kangaroos. The places in which these Pocket Mice are found are so bare of vegetation and destitute of water, that it is difficult to imagine how they contrive to exist. In all probability they pick up a scanty living in the shape of roots and grasses, especially seeds, carrying a supply for the day into their holes in their great cheek-pouches.

The Yellow Pocket Mouse and the Least Pocket Mouse (*Cricetodipus flavus* and *parvus*) are very minute creatures, only about two inches long in the head and body. The tail is longer than the head and body in the latter, shorter in the former species, and the colour of the fur in both is a pale buff. These species are found in the Rocky Mountains and the region west of that range to the Pacific, the latter being inhabited by the second of the above species. Several species of the genus *Heteromys* inhabit Central America, and one is found in the island of Trinidad. Nothing appears to be known of their habits.

From these we pass as by a natural transition to

FAMILY X.—DIPODIDÆ (THE JERBOAS).

The Jerboas are a more extensive and much more widely distributed family of hopping Rodents. In these we find the organisation for jumping brought to greater perfection than in any other group. The body is light and slender, the hind limbs much elongated, the fore limbs very small, and the tail long and usually tufted at the end. The number of toes on the hind feet varies from three to five, and the metatarsal bones are very often united so as to form what is called a "cannon bone" in the Horse. The incisor teeth are compressed; the molars sometimes four, but usually three in each series, rooted or rootless, not tuberculate; the infra-orbital opening is rounded and very large, and the zygomatic arch slender. The great home of these animals is the vast steppe region which stretches from South-eastern Europe across the greater part of Central Asia, but they extend southwards round the eastern extremity of the Mediterranean, through Syria and Arabia to Egypt and Africa, over a great part of which they are found, and eastward to India, Afghanistan, and Ceylon. A single species occurs at the Cape of Good Hope; and another is found in North America. We may commence by noticing this last species, as it not only makes the nearest approach to those of preceding families, especially the Muridæ, but differs from the rest of the Jerboas in characters of such importance, that Dr. Coues maintains its right to form a separate family (*Zapodidæ*).



SKULL OF THE CAPE JUMPING HARE.

The American Jumping Mouse (*Zapus* hudsonius*) has a wide range, extending across

* Dr. Coues has proposed this generic name for the American Jumping Mouse, as the names *Jaculus* and *Meriones*, given to the genus by various authors, had been previously used for other groups.

the continent of North America from sea to sea, and from Labrador, Hudson's Bay, and the Great Slave Lake in the north, to Virginia and the elevated portions of Arizona and New Mexico in the south. It is an elegant little mouse-like creature, rather more than three inches long, and furnished with a cylindrical tail, which exceeds the head and body in length by about two inches. Its hind limbs are not quite so disproportionately developed as in the other members of the family. Its fur in summer is of a brown colour above, becoming yellowish on the sides and white below; in the winter the brown tint covers the whole surface. The ears, which are not very large, are black, with a light-coloured rim; the hind feet are greyish, and the fore feet whitish on the upper surface; and the tail, which tapers to an exceedingly fine point, where there is a fine pencil of hairs, is ringed and nearly naked.

The characters in which this animal differs from its nearest relatives are as follows :—In the upper jaw there are four rooted molars on each side, the first being very small, the second the largest, and the rest gradually diminishing in size; the fore feet have the thumbs rudimentary, and the hind feet

AMERICAN JUMPING MOUSE.

have five toes, all of which touch the ground; the metatarsal bones are separate; and the soles of the feet naked, with granules and small horny shields.

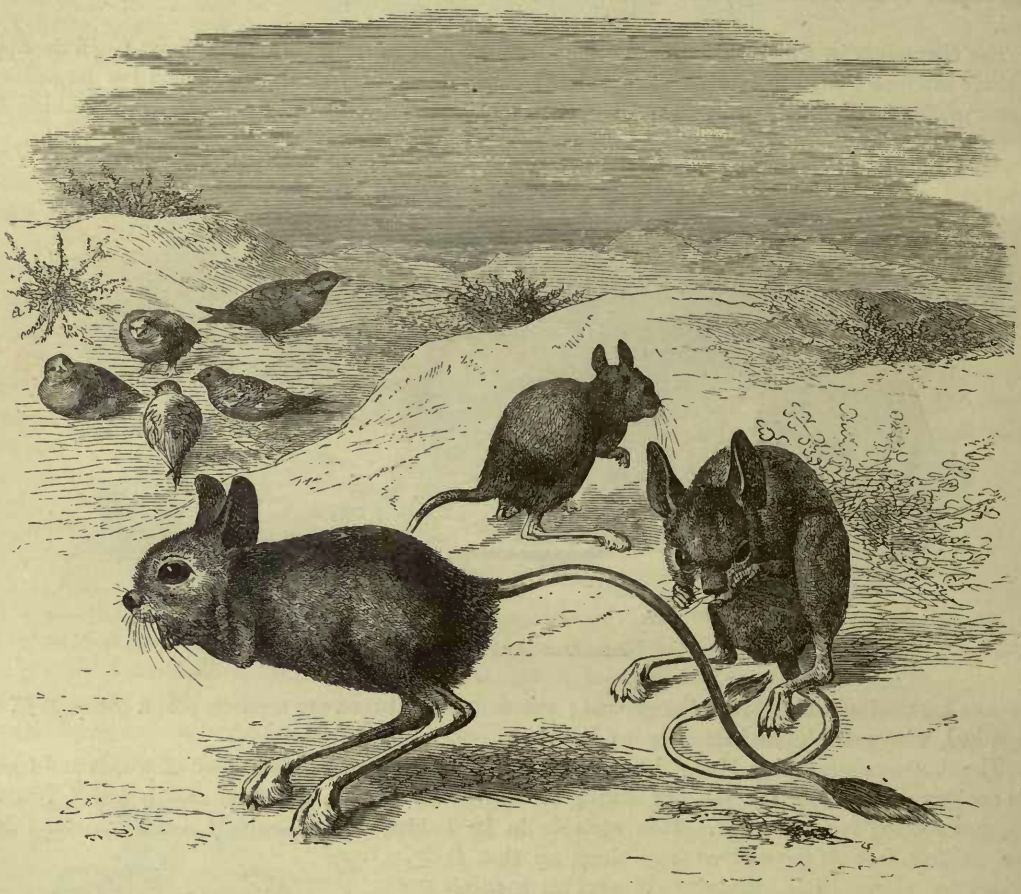
The American Jumping Mouse is found in meadows in the neighbourhood of woods and copses. It is nocturnal in its activity, sleeping during the day in its burrow, which is usually about two feet deep, and coming forth at night. It is sociable in its habits, and excessively active, covering from three to five feet of ground at each leap, so that it is a matter of no little difficulty to capture a specimen in the open. In the woods it is worse, as the little creature will bound over bushes, and get out of sight in a moment. Its food consists of seeds of various kinds, and it is exceedingly fond of beech-mast. For protection from the cold of winter the Jumping Mouse makes a little hollow clay ball, within which it coils itself up, and goes comfortably to sleep. The nest is made about six inches under the surface of the ground, and is composed of fine grass, sometimes mixed with feathers, wool, and hair; and in this the female produces from two to four young, probably several times in the course of the summer, as the nests and young are to be found from May to August.

MOLAR TEETH OF THE JERBOA.

If we regard the American Jumping Mouse as constituting a peculiar section of the family, ZAPODINÆ, a second group, DIPODINÆ, is formed by the TRUE JERBOAS, which make up the greater

part of the family. These either possess only three molars, or a very small additional tooth exists in front of each series in the upper jaw. The molars are rooted, and diminish in size backwards in each series. The cervical vertebræ are anchylosed; the fore feet have the thumbs rudimentary, but sometimes furnished with a small nail; the hind feet have only three toes fully developed, and the metatarsals are united into a single bone of great length; the soles are furnished with elastic balls; and the tail is very long, well-clothed with hair, and tufted at the end.

Of these pretty little creatures, which are in some respects singularly bird-like, about twenty species have been recorded, and these occupy the whole of the Old World area of the family, except



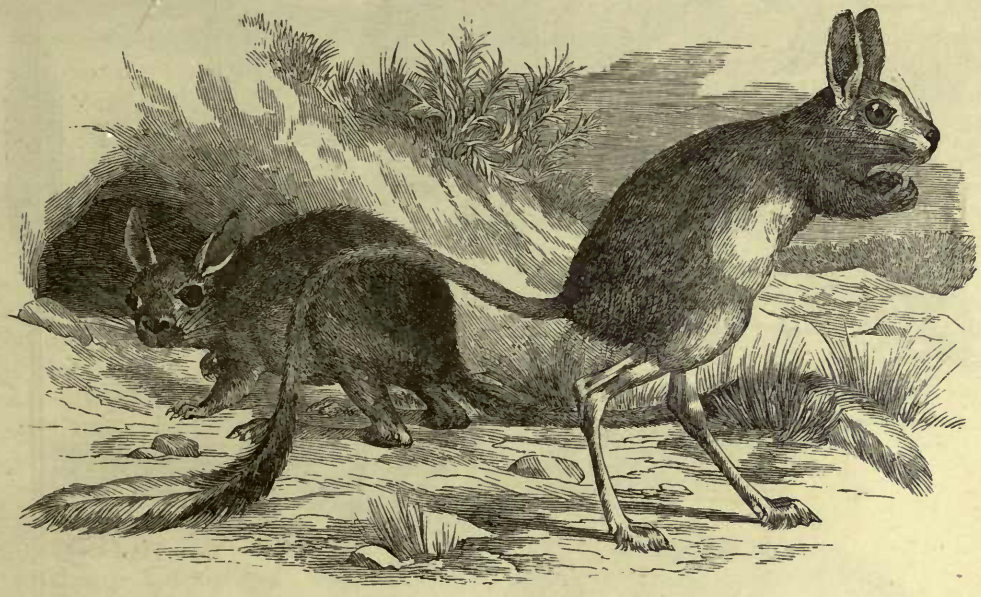
JERBOA.

South Africa. The Jerboa (*Dipus ægyptius*) may serve as an example of this section of the family. This is a most lively and active little creature, which inhabits the deserts of north-eastern Africa as far south as Nubia, and extends its range into Arabia and south-western Asia. On these arid plains, so scantily clothed with a few grasses and dry shrubs that it is difficult to conceive how any animal can find a living on them, the Jerboa lives, often in numerous societies, and in company with the few birds and lizards which enliven the wilderness. These animals dwell in subterranean abodes consisting of many branched galleries, which they dig out in the hard soil not far from the surface. The Arabs assert that these habitations are produced by the joint labour of the whole society. They retreat into their burrows at the least alarm. The females are said to produce from two to four young at a birth in a nest made in the deeper part of the burrow, and lined with hair pulled from the under surface of her own body. When going along quietly, the Jerboa walks and runs by alternate steps of the hind feet, but when there is occasion for rapid motion it springs from both feet at the same time, covering so much ground at each leap, and touching the ground so momentarily between them,

that its motion is more like that of a bird skimming close to the surface of the ground than that of a four-footed beast.

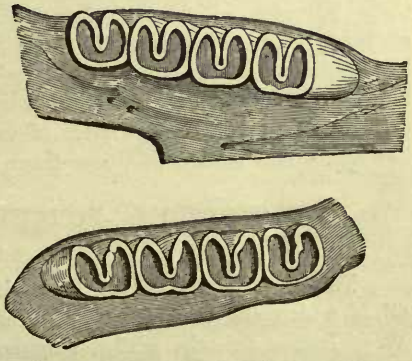
The Jerboa is about six inches long, with a tail about eight inches in length exclusive of the tuft with which its tip is adorned. Its upper surface is of a greyish sand-colour, like that of many other desert animals; the lower surface is white; and the tail pale-yellowish above and white beneath, with the tuft white, with an arrow-shaped black mark on its upper surface.

Several other species of Jerboas are known, some from the deserts of North Africa, others from the steppes of Central Asia. The latter region harbours some forms, which differ from the preceding, among other characters, by having five toes in the hind feet, whereas the true Jerboas have only three, but of the five toes only three are sufficiently developed to take part in the animal's progression. The best known of them is the ALACTAGA (*Alactaga jaculus*), a rather larger species than the Jerboa,



ALACTAGA.

and with a still longer tail, reddish-yellow with a greyish tinge above, white beneath and on the hind legs. Its range extends from the Crimea and the steppes of the Don across Central Asia to the borders of China. It walks upon all-fours, and when advancing quickly springs along after the fashion of the Jerboa. Its food consists of all sorts of vegetable substances, but it is especially fond of the bulbs of plants, and does not refuse occasionally to eat insects, or even the eggs and young of the birds which inhabit the steppes with it. The Alactagas live in very complicated burrows, with many passages and branches, and they are said always to make one passage from the central chamber of their residence, which terminates close to the surface of the earth at some distance, but is only opened in case of danger, when the inhabitants escape through it, the position of its intended aperture being previously unrecognisable. In cold weather they sleep in their nests. The female produces from five or six to eight young, in a nest lined with her own hair. Species of *Alactaga* occur not only in Central Asia, but also in Arabia and North Africa.



MOLAR TEETH OF THE JUMPING HARE.

South Africa produces one species, the CAPE JUMPING HARE (*Pedetes caffer*), which constitutes a distinct sub-family, PEDETINÆ, having four rootless molars on each side in each jaw, the metatarsal bones

CAPE JUMPING HARE.

separate, the tail bushy, and the hind feet furnished with four toes having broad, hoof-like nails. This is a much larger animal than any of the preceding, being about the size of the common Hare, which it also resembles in its colours. The Jumping Hare inhabits a considerable portion of South Africa, extending on the west coast at least as far as Angola. It is abundant at the Cape of Good Hope, both in the mountains and in the plains. Great numbers of the animals often live together, and their burrows, which, like those of other Dipodidæ, are inhabited by numerous individuals as a common residence, consist of many-branched galleries made at no great depth from the surface, but leading into a more deeply-seated habitation. They generally go about slowly upon all-fours, but can advance with extraordinary rapidity by Kangaroo-like springs, in each of which, when pressed, they will cover a space of twenty or thirty feet. Their food consists of roots, seeds, and herbage. The female produces three or four young at a birth.

SECTION III.—PORCUPINE-LIKE RODENTS (*HYSTRICOMORPHA*).

FAMILY XI.—OCTODONTIDÆ.

This first family of the Porcupine alliance consists of a number of rat-like animals, nearly all of which are inhabitants of South America, three species only being peculiar to the large West Indian Islands, whilst, singularly enough, four more are known from different parts of the African continent. Except in one of these last, all the members of the family have four molars on each side in each jaw, and the crowns of these teeth show internal and external folds of enamel. The malar portion of the zygomatic arch has an angular process at its lower margin.

The hind limbs are not disproportionately developed, and both they and the fore feet are nearly always furnished with five toes, armed with curved claws; and the clavicles are perfect. The ears are generally short and sparingly hairy, and the tail, which is of various lengths, is either clad with short hairs, or naked and scaly.

We may begin with two African species of this generally American family, which have the two inner claws of the hind feet furnished with comb-like fringes of horny bristles, whence the name of *Ctenodactylus* has been applied to the best known species. These two species, which exhibit strong affinities to the Jerboas, form the sub-family CTENODACTYLINÆ. The GUNDI (*Ctenodactylus Massoni*) has only three molars on each side in each jaw, and only four toes upon each foot. It is an animal about the size of the Water Rat, but with a mere stump of a tail, very small ears, very long whiskers, and the hind limbs rather longer than their fellows. It lives in North Africa, chiefly on the borders of the Sahara, where it takes up its abode in the rocky hills, and descends therefrom to the cultivated grounds to feast upon the growing corn. It is diurnal in its habits, but exceedingly shy and watchful, making off to its fastnesses at the least appearance of danger. *Pectinator Spekei*, a species named after its discoverer, the celebrated African traveller, is nearly related to the preceding, but has a small additional molar in each series. The tail is of moderate length, and bushy, and the ears have a small antitragus. It inhabits the Somali land in the interior of North-eastern Africa.

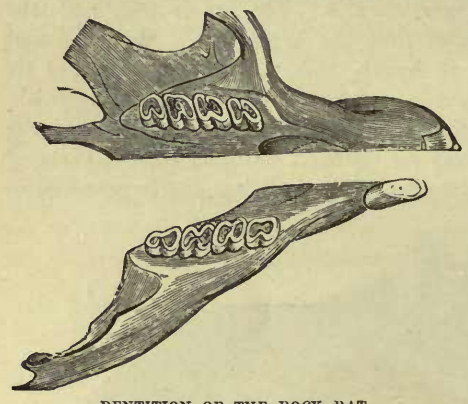
The DEGU (*Octodon Cumingii*), a very abundant species in Chili, which also extends into Peru, may be taken as a typical example of the whole family, and also of its typical sub-family OCTODONTINÆ, in which the molars are simply indented on each side. The fur is soft, and the tail is short. The Degu is a rat-like animal, rather smaller than the Water Vole, the head and body measuring from seven and a half to eight inches in length, and the tail, exclusive of its terminal tuft, rather more than half that length. The general colour of the animal is brownish-yellow, pencilled with black on the back; the lower surface is yellowish, the feet white, and the tail dusky above, whitish beneath, with the tufted tip dusky or blackish. In the central parts of Chili, according to various travellers, the Degu is exceedingly abundant, living in large societies about hedges and thickets, and running about boldly, even on the high roads. The animals make their burrows in the hedge-banks and similar places, and when alarmed rush into them with their tails elevated, very much after the manner of Rabbits. As the burrows communicate freely with each other, the Degus can easily escape pursuit, going in at one opening and coming out at another at some considerable distance. They sometimes climb up into the bushes among which they live. Their ordinary food consists of the herbage which grows about their dwelling-places, but they also invade gardens and fields, where they may do considerable damage. In the winter they will feed upon the tender bark of certain trees, but they are said by some authors to lay up a store of food against this season. They do not become torpid. The female is believed to produce two broods in the year, each consisting of from four to six young.

DEGU.

Two other species of *Octodon* are known from Chili and Bolivia, which region is also inhabited by two species of *Habrocoma*, a genus distinguished by the large size of the ears, and the extreme softness of the fur. In these animals the molar teeth differ in the two jaws, the upper ones being as simple as in the preceding species, while the lower ones show a complication of the enamel folds like what we shall meet with in the third sub-family.

The Brown Schizodon (*Schizodon fuscus*), which inhabits certain elevated spots in the southern part of the Andes (75° S. lat.), has the enamel folds of the molar teeth meeting in the middle. It is about the size of the common Rat (seven and a half to nine inches long), and has a shortish tail clothed throughout with short hairs. Its fur is dark brown above, dirty yellowish beneath. This animal inhabits grassy places near mountain streams, where the ground is sometimes so undermined by its burrows as to render travelling on horseback very uncomfortable. It is a nocturnal animal, and passes most of its life underground. The valleys it inhabits are covered with snow for at least four months in the year.

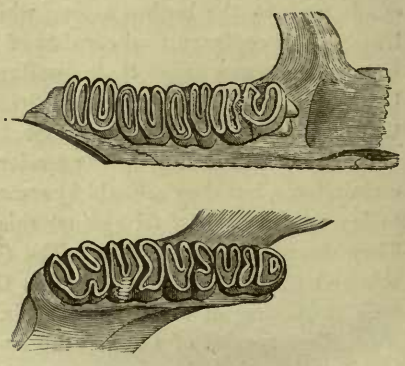
In the Tukotuko (*Ctenomys brasiliensis*) and its congeners, about four of which are known from different parts of South America, one of them extending as far south as the Strait of Magellan, the eyes and ears are very small, and the animal seems to be still more specially adapted to a subterranean mode of life. In these animals the claws are longer than the toes, and those of the hind feet are fringed with a sort of comb formed of bristles. The incisor teeth are very broad. The Tukotuko is about the size of a large Rat, namely, from eight and a half to nine and a half inches long, with the tail from two and a half to three and a half inches. Its name is in imitation of the sound which it constantly emits—a sound which rather surprises a stranger when he first hears it, seeing that the animal uttering it is concealed underground. In many places, as in the Argentine Republic, this animal is exceedingly numerous, living generally in sandy soil, but sometimes in damp situations. It makes long burrows not far from the surface, and thus in some places completely undermines the ground. In making these galleries the Tukotuko is engaged in the search for its food, which consists chiefly of the roots of plants. According to Azara, it lays up stores of food in its burrows. Its activity is nocturnal.



DENTITION OF THE ROCK RAT.

The Cururo (*Spalacopus Pöppigii*) has the ears quite rudimentary, and is also organised for a subterranean existence. This and another species inhabit Chili, where they make extensive burrows in the ground, and feed upon the bulbous and tuberous roots of various plants, large stores of which they collect in their subterranean abodes. These magazines are sought out by the poorer people, and their contents used as food.

The Rock Rat (*Petromys typicus*), although most nearly allied to the preceding species, lives on the opposite side of the Atlantic in the rocky hills of South Africa, especially towards the mouth of the Orange River. It differs from the preceding forms in the harshness of its fur, in which it resembles another sub-family of Octodontidæ, in the shortness of its thumbs, which are furnished with a small nail, and in its rather bushy tail. The molars are semi-rooted, with the enamel folds nearly meeting in the middle. The whiskers are of great length, and entirely black. The general colour is reddish-brown, with the head and fore parts greyish, the throat whitish, and the belly pale yellow. The tail is of the colour of the body at the root, with the remainder black. The length of the animal is about seven and a half inches, of the tail from five to five and a half inches. It feeds upon various vegetable substances, and appears to be very fond of the flowers of syngenesious plants, especially a species of groundsel, which it eagerly devours. It forms its retreat among loose stones, or in crevices of the rocks.



TEETH OF THE SPINY RAT.

While the Octodontinæ may be regarded as specially characteristic of the region of the Andes, the other great group of this family is almost exclusively confined to the country east of that great chain, and to some of the West Indian islands. Curiously enough this sub-family also has a single

representative in Africa. Its members are distinguished at once by the complicated enamel folds of their molar teeth in both jaws, by these teeth being generally rooted, and by the texture of the fur, which is harsh and frequently mixed with fine spines. Hence the name of *Echinomys* (Spiny, or rather Hedgehog, Rat), applied to the typical genus, from which the sub-family is named ECHINOMYINÆ. The tail in these animals is usually long.

The Rodents belonging to this sub-family are generally of considerable size, as large as Rats, or larger, stoutly built, with the hinder part of the body larger than the fore-quarters, with limbs of moderate length, the hinder larger than the anterior, the former furnished with five toes, the latter with four complete digits and a rudimentary thumb, and the toes armed with strong curved claws. The tail is scaly, with scattered hairs. In their habits these animals appear to be strictly vegetable-feeders, but in other respects they present some variety. The majority live in and upon the ground; but one or two are arboreal, and one aquatic, in their mode of life.

The last species alluded to is the well-known COYPU (*Myopotamus Coypus*), one of the largest of Rodents, which occurs in nearly all parts of South America and on both sides of the Andes, from the tropic of Capricorn to about 15° N. lat. It is usually about twenty inches long, but often attains still greater dimensions. The tail, which is about two-thirds the length of the head and body, is scaly, with hairs about as thickly scattered as in the common Rat. The ears are of moderate size; the incisor teeth very large and powerful; the molars, the hindmost of which are the largest, have two internal and two external enamel-folds in the upper, and three internal folds and one external in the lower, jaw; the hind feet are webbed. The general colour of the upper surface is brown, produced by dusky and brownish-yellow pencilling; the sides and under parts are brownish-yellow, and the front of the muzzle and the chin white.

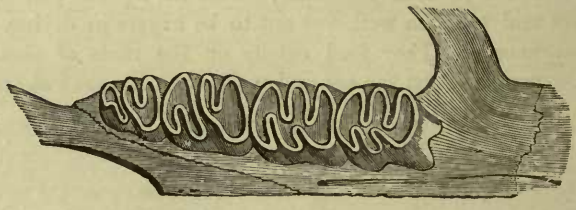
The Coypus live upon the shores of the rivers and lakes of South America, generally, according to Rengger, in pairs, each pair digging for themselves a burrow in the bank, which extends to a depth of three or four feet, and widens out into a cavity eighteen inches or two feet in diameter. Here they pass the night, and take refuge when necessary during the day. They select for their dwelling-places the stiller parts of the water, where the aquatic plants on which they chiefly feed grow freely. They are said to swim well, but not to be expert in diving. On land they are slow and awkward in their movements. They feed chiefly on the roots of plants, but in the Chonos Archipelago, where the Coypus frequent the sea and make their burrows at some little distance from the beach, they are said

COYPU.

HUTIA CONGA.

occasionally to eat shell-fish. The female produces from four to five young once in the year. The little animals very early accompany their mother into the water, when she swims with them on her back, until they have acquired the art of swimming. Mr. Waterhouse thinks that this habit may "explain the singular position of the nipples noticed in the female Coypu. Of these four were found by Mr. Lereboullet on each side of the body, and situated rather above the mesial line of the flanks, the foremost being placed behind the shoulder, and the hindermost in front of the thigh." The Coypu is hunted for the sake of its flesh, which is described as white and of good flavour, and of its

TEETH OF PLAGIODON.

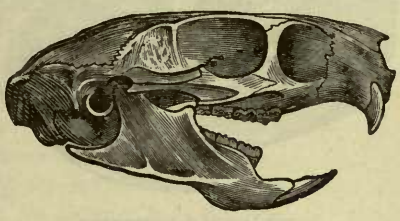


MOLAR TEETH OF LONCHERES.

skin, which is well known in the fur trade under the name of "Nutria," signifying Otter. Great quantities of these skins are annually exported from Buenos Ayres. It is said to be a courageous animal, fighting bravely with the dogs engaged in chasing it.

The Hutia Conga (*Capromys pilorides*) is another large Rodent, measuring from twenty to twenty-two inches in length, with a stout rat-like tail about half as long as the head and body. It is an inhabitant of Cuba. The incisors are considerably smaller and weaker than in the Coypu; the upper molars have one internal and two external folds; the lower ones are similar but reversed. The fur, which is long, is very harsh, and consists of a mixture of black and yellow hairs, becoming rusty on the hinder part of the body. The belly is rusty yellow. This animal lives in the dense

forests of Cuba, where it resides either upon the trees or in the thick underwood. It is a nocturnal or crepuscular animal, and is tolerably active when going about on the branches of trees, but is less at home on the ground. Its food consists of fruits, leaves, and the bark of trees, but, according to M. Ramon de la Sagra, it does not disdain animal food, and is especially fond of a species of Lizard belonging to the genus *Anolis*. On the other hand, the negroes are very partial to the flesh of the Hutia, and they capture the animal either by snaring it on the branches of trees, or by sending Dogs after it. Like the Coypu, it is said to fight courageously against its pursuers. Another Cuban species, the HUTIA CARABALI (*C. prehensilis*), has a slightly longer tail, which is prehensile at the tip. It is described as keeping chiefly to the highest branches of the trees. In St. Domingo there is an allied form, *Plagiodon œdium*, in which the enamel folds of the molars are singularly complex (*see* figure on p. 132). This animal frequents the neighbourhood of human habitations, and approaches them at night in search of its food, which consists of fruit and roots. In most of the other members of this sub-family, which appear to be terrestrial in their habits, the intermixture of spines with the fur of the back is a striking character. In the genus *Echinomys* itself, and in *Loncheres*, which together include about a dozen species found chiefly in Guiana and Brazil, the spines frequently form the principal outer covering of the back. Side by side with these hedgehog-like species, however, others occur in which the fur is soft.



SKULL OF LONCHERES.

The GROUND RAT (*Aulacodus Swinderianus*), of Western and Southern Africa, is remarkable as being the sole representative of this group outside the South American province. It has very broad incisors, and those of the upper jaw exhibit three deep grooves; the molars show the same arrangement of folds as in *Capromys;* the fur is harsh and bristly, and of a general brown tint; and the tail is of moderate length, sparingly haired, dusky above, and whitish below. The fore feet have the thumb rudimentary and the outer toe very short; and the hind feet have only four toes, of which the outer one is rudimentary. This curious animal, which is nearly two feet long, is known to be an inhabitant of Sierra Leone and the Gambia, and also of South Africa (Port Natal); in all probability it occurs at many intermediate localities. In Sierra Leone it is known as the Ground Rat, or Ground Pig, and is said to feed upon ground nuts, and cassada and other roots in search of which it digs into the ground, where it also forms large burrows for its residence.

CHAPTER IV.

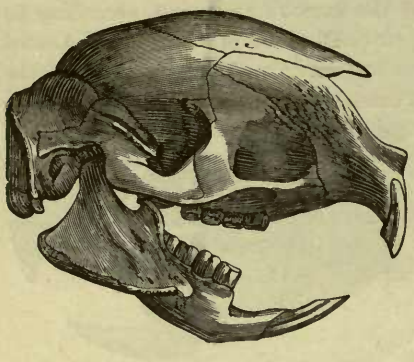
PORCUPINES—CHINCHILLAS—AGOUTIS—CAVIES—HARES AND RABBITS—PIKAS.

HYSTRICIDÆ, THE PORCUPINES—Conversion of Hairs into Spines—Skull—Dentition—Tail—Sub-families—The True Porcupines—The Tree Porcupines—THE COMMON PORCUPINE—Distribution—Description—The Crest of Bristles—Nature of the Spines—Habits—Young—Flesh—On the Defensive—Other Species—Species of Tree Porcupines—THE COUENDOU—THE COUIY—Description—Habits—THE URSON, OR CANADA PORCUPINE—Description—Habits—Food—CHINCHILLIDÆ, THE CHINCHILLAS—Characteristics—THE VISCACHA—Description—Life on the Pampas—Their Burrows—Habits—The Chinchillas of the Andes—THE CHINCHILLA—THE SHORT-TAILED CHINCHILLA—CUVIER'S CHINCHILLA—THE PALE-FOOTED CHINCHILLA—DASYPROCTIDÆ, THE AGOUTIS—Characters—THE AGOUTI—Distribution—Appearance—Habits—AZARA'S AGOUTI—THE ACOUCHY—THE PACA—Appearance—Distribution—Habits—DINOMYIDÆ—Founded for a Single Species—Description—Rarity—CAVIIDÆ, THE CAVIES—Characteristics—THE RESTLESS CAVY—Appearance—Habits—The Guinea-Pig Controversy—THE BOLIVIAN CAVY—THE ROCK CAVY—THE SOUTHERN CAVY—THE PATAGONIAN CAVY, OR MARA—Peculiar Features—Its Burrows—Mode of Running—THE CAPYBARA—Its Teeth—Where Found—Habits—THE DOUBLE-TOOTHED RODENTS—Characteristics—LEPORIDÆ, THE HARES AND RABBITS—Structural Peculiarities—Distribution—Disposition—THE COMMON HARE—Hind Legs—Speed—Its "Doubles"—Other Artifices—Its "Form"—Habits—Food—Pet Hares—THE RABBIT—Distribution—Habits—Domesticated—THE MOUNTAIN HARE—LAGOMYIDÆ, THE PIKAS—Characteristics—Distribution—THE ALPINE PIKA—THE ROCKY MOUNTAIN PIKA.

FAMILY XII.—HYSTRICIDÆ (PORCUPINES).

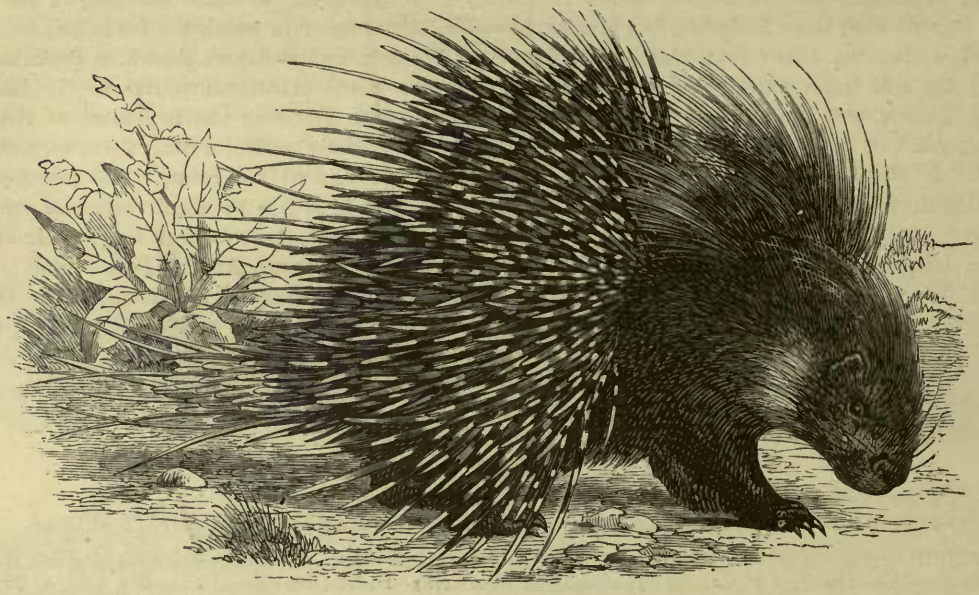
THIS second family of the section Hystricomorpha exhibits the conversion of the hairs into spines in perfection, the whole upper part of the body being in several instances completely

covered with long, hollow, pointed quills, whilst in all cases great numbers of spines and stiff bristles are mixed with the hair. The form of the skull in these animals is distinctive. It is ovate, the cranial portion being more or less inflated by air-cavities in the bones, and the facial portion short, but the occipital or hinder surface is usually nearly perpendicular; the malar portion of the zygoma has no angular process as in the preceding family; the molar teeth are four in number on each side in each jaw; and the limbs are about equal in development. The incisor teeth are large and powerful. With regard to the development of the tail there are considerable differences, some species having that organ quite short, while in others it is of moderate length, or long and sometimes prehensile.



SKULL OF THE PORCUPINE.

The Porcupines fall readily into two distinct groups (sub-families) characterised by structure, habits, and geographical distribution. In the strictly terrestrial species, or True Porcupines (Hystricinæ), which inhabit the warmer parts of the eastern hemisphere, the skull is rather more elongated than in the others; the front margin of the orbit is over the third molar; the molars are



COMMON PORCUPINE.

rootless when young, but become closed after a time, and the clavicles are imperfect. The upper lip is furrowed; the tail, which may be either long or short, is never prehensile; the soles of the feet are smooth; and the female has six teats.

The arboreal species (Sphingurinæ), which are all American, have the skull peculiarly short, the front margin of the orbit over the first molar, the molars always rooted, and the clavicles perfect. The upper lip is not furrowed; the tail is moderate or long, and generally prehensile; the soles of the feet are covered with wart-like tubercles; and the female has only four teats.

The Common Porcupine (*Hystrix cristata*) may serve as a characteristic and well-known example of the first of these two groups. It is an inhabitant of the Mediterranean region, occurring in most parts of North Africa, and extending as far southwards as the Gambia and Soudan; in Southern Europe it is abundant in Italy, Sicily, and Greece. It measures about twenty-seven or twenty-eight inches in length to the root of the tail, which is about four inches long. The head, shoulders, limbs, and under parts are clothed with short spines intermixed with hairs usually of a dusky or brownish-

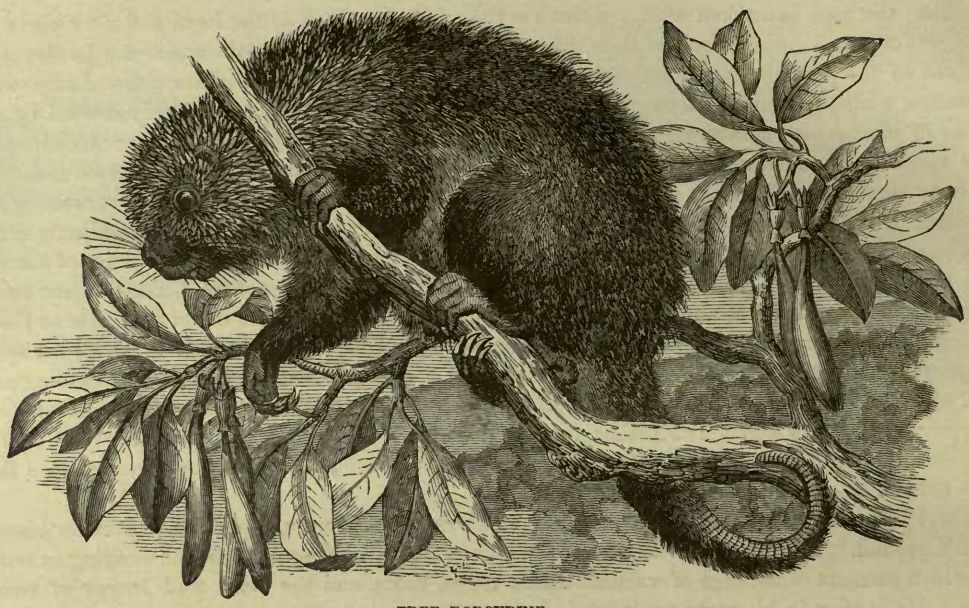
black hue; the neck is marked with a whitish collar; from the back of the head and neck there rises a great crest of long bristles, many of them fifteen or sixteen inches in length, which can be elevated and depressed at the pleasure of the animal, are gently curved backwards, and are either dusky with the extremities white, or whitish throughout; the hinder portion of the body is entirely covered by a great number of long, sharp spines, ringed with black and white, but always having the extremities white. These spines vary considerably in size, some of them being very long (fifteen or sixteen inches), comparatively slender and flexible; others shorter (from six to twelve inches), but much stouter. They are all hollow, or filled only with a sort of spongy tissue, but from their structure are exceedingly resistant, and when the animal erects them, which he is able to do by contracting the muscles of the skin in which their roots are imbedded, they constitute a most formidable armature. They appear to be but loosely attached to the skin, and readily fall out, a circumstance which no doubt gave rise to the belief prevalent among the ancients (and many moderns) that the Porcupine was able to shoot his spines at an approaching enemy, or even to project them behind him at a pursuer when he was rushing away in search of a place of safety. The tail of the animal bears at its tip about twenty spines of very curious construction; they are about two inches long, hollow, open, and cut off square at the end, and about a quarter of an inch in diameter for the greater part of their length, but they are inserted into the skin by the extremity of a thin stalk half an inch long.

The Porcupine lives in holes among the rocks, or in a burrow, which he makes for himself in ordinary ground. In this retreat he passes the day in sleep, coming forth in the evening in search of food, which consists of herbage of various kinds, fruits, roots, and the bark and leaves of trees and bushes. He is slow in his movements, and does not even display much activity in burrowing. His habits are solitary except during the pairing season; and during the winter he passes most of his time in his habitation, without, however, falling into a torpid state. The pairing takes place early in the year, but varies in this respect according to the climate of the locality; and in the spring or early summer the female produces from two to four young, in a nest carefully lined with leaves, grasses, roots, and other vegetable substances. The young Porcupines are born with their eyes open, and their bodies are covered with short, soft spines, which are pressed closely to the body. These speedily harden and grow longer, and the young do not appear to remain very long with their mother. The flesh of the Porcupine, like that of most purely vegetable-feeding Rodents, is very good, and is eaten in the countries where the animal occurs. When pursued or irritated, he stands on the defensive, erects his formidable quills and crest, stamps on the ground with his hind feet after the manner of a Hare, jerks himself towards the object of his dread, as if to wound it with his spines, and at the same time produces a curious noise by rattling the open quills of the tip of his tail. But all these manœuvres are generally in vain, and the Porcupine, in spite of his defensive armour, is pretty easily captured by those who know how to set about it. The Leopard is said to manage the business at once by a single blow of his paw on the head.

A very similar Porcupine (*Hystrix hirsutirostris*) takes the place of this species in Syria and Asia Minor, and extends thence eastward to India; another (*H. javanica*) inhabits the Sunda Islands; and the district of Nepaul has a peculiar species of its own. In Siam and Malacca, and on the west coast of Africa, we find two species of an allied genus, in which the spines of the body are comparatively short and depressed, and the tail is elongated, scaly, with a few scattered bristles in the middle, and with a large tuft of long flat bristles at the tip. The Malayan species (*Atherura fasciculata*) is about eighteen inches long, the African one (*A. africana*) about fourteen inches. Both are somewhat rat-like in their form.

The Tree Porcupines, forming the second sub-family, several species with prehensile tails, range over the continent of South America, east of the Andes, and one of them, the Mexican Tree Porcupine (*Sphingurus mexicanus*), is found as far north as Guatemala and Southern Mexico. The most abundant and widely-distributed species in the Brazilian region are the Couendou (*Sphingurus prehensilis*) and the Couiy (*S. villosus*), inhabiting Guiana, Brazil, and Bolivia, the latter being found throughout the forest region of Brazil and as far south as Paraguay.

These animals are of considerable size, usually measuring from sixteen to twenty inches in length without the tail, which is about one-third the length of the head and body. By the aid of the prehensile tip of this organ they climb with great facility and security upon the branches of the trees, but



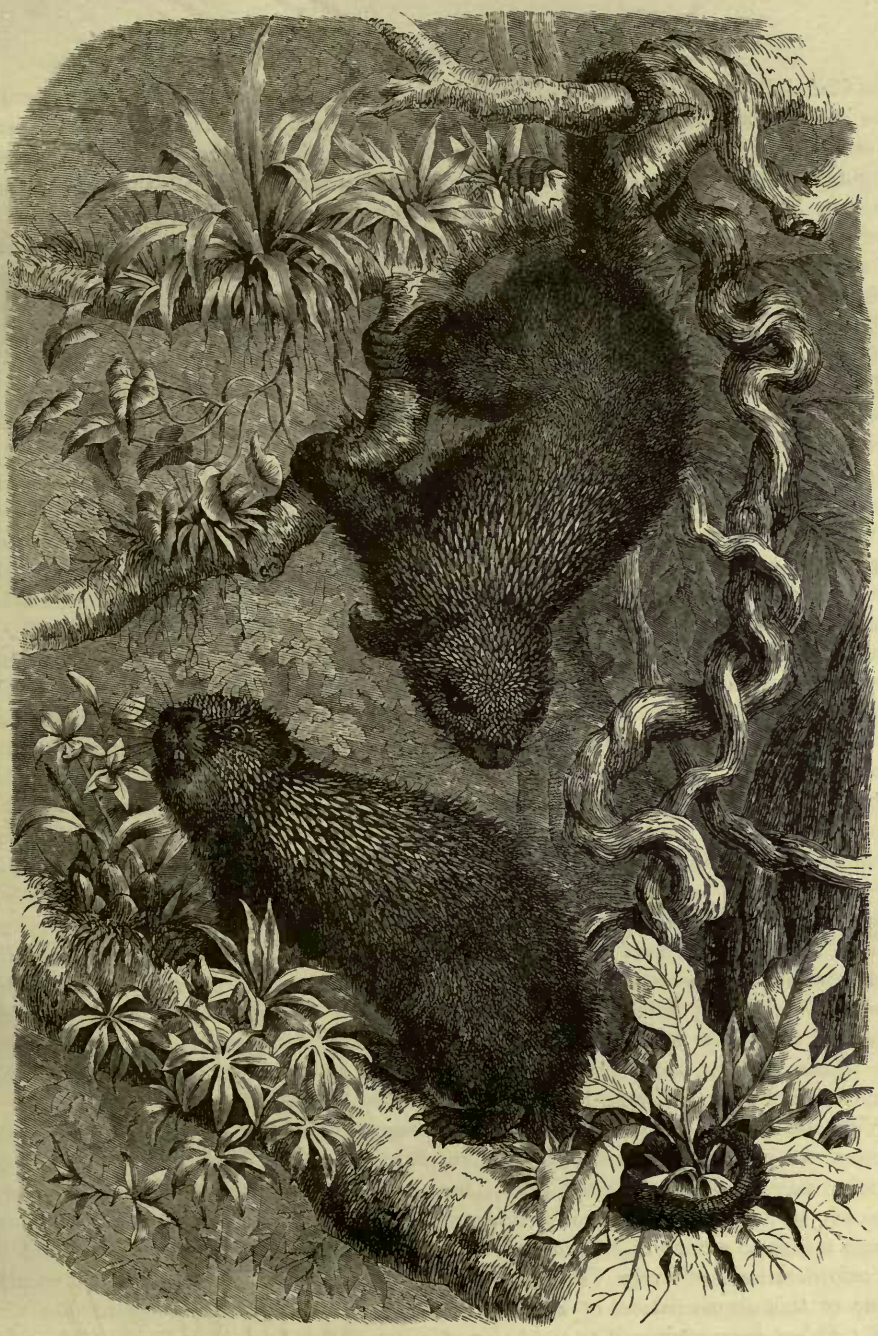
TREE PORCUPINE.

their feet are also specially adapted for this particular mode of activity, and they are said even to climb the palm-trees in order to feed upon their fruit. They are nocturnal in their habits, passing the day in sleep concealed in the fork of a branch, and going abroad at night in search of their food, which consists of fruits of various kinds, and the buds, leaves, and even flowers, of the trees on which they live. Roots also form a part of their nourishment, probably when they reside rather among thickets than in the high forest. Their spines, although short when compared with those of the Common Porcupine, are formidable defensive weapons when the animal erects them; in some species, as especially in the Couiy, they are concealed, when depressed, by the long hair, and, according to Hensel, this serves as a protection to the animal from rapacious birds, for, when it sits in a heap, sleeping away the daylight, these soft grey hairs give it a most deceptive resemblance to a mass of the beard-moss which so commonly grows on the trees in the Brazilian forests.

The Urson, or Canada Porcupine (*Erythizon dorsatus*), the only North American species of the family, according to Mr. Allen, although other writers distinguish two or three such forms, is about two feet or more in length when full grown, and is covered with woolly hair, and with long coarse hair of a dark brown colour, with the points white or yellowish, this difference in the colour of the tips of the hairs being the chief distinction between the two varieties which Mr. Allen recognises. The spines in both forms are white, with the points usually dusky or brown. The Canada Porcupine is distributed through the whole of the Eastern United States, except on the seaboard, from New York to Virginia, and north of the States through Canada, as far as the limit of trees. The Western Porcupine, which has the tips of the long hairs yellowish (whence it has received the name *E. epixanthus*), occurs west of the Missouri river, extending to the Pacific shores and going southward along the mountains to Arizona and New Mexico, and northwards at least as far as Alaska and Sitka.

Although a heavy and clumsy-looking beast, and destitute of the prehensile tail of its South American cousins, this Porcupine is a good climber, and passes nearly the whole of its life upon trees; nevertheless, according to Mr. Allen, it may be met with travelling upon the prairies, probably on its way from one suitable residence to another. On the ground it moves slowly, but its armature of spines is a protection against most of its enemies, and it has the art of striking very forcible and judicious blows with its spiny tail. Audubon and Bachmann mention many cases in which Dogs, Wolves, and even a Puma were found dead or dying in consequence of the severe inflammation caused by the spines of this animal sticking about their mouths; and the former gives an interesting account of a lesson in

urbanity given by a captive Urson to a Mastiff that attacked him. The food of the Urson consists of various vegetable substances, fruits, buds, and the young shoots and leaves of trees. In the winter it



MEXICAN TREE PORCUPINES.

subsists chiefly upon the bark, which it strips off the upper branches of the trees, and when it has taken up its abode upon a tree it stays there until the suitable bark has been consumed. As it prefers young trees this operation is generally effected pretty quickly, and in this way it is estimated that a single

Porcupine may destroy hundreds of trees in the course of a winter. The Urson resides in the holes of trees, and in such situations, or in crevices among the rocks, the female prepares her nest, in which she brings forth usually two, but occasionally three or four, young in April or May.

FAMILY XIII.—CHINCHILLIDÆ (THE CHINCHILLAS).

In the Chinchillas, which form a small family peculiar to South America, the incisor teeth are short; the molars are rootless, divided by continuous folds of enamel into transverse plates, and the two series in each jaw converge towards the front; the zygomatic arch has no angular process on the lower margin; the clavicles are slender but perfect; the fore limbs are small, the hind limbs long; the tail of moderate length or long, and turned up at the end; and the fur is very fine and soft. They are Rodents of moderate size and more or less of Rabbit-like appearance, except that the tail is always elongated and bushy. Of the five known species, four are inhabitants of the mountain regions, and one lives in the plains of the region of La Plata.

The latter, the Viscacha (*Lagostomus trichodactylus*), is a stout-built and almost Marmot-like creature, from eighteen inches to two feet long, exclusive of the tail, which measures from six to eight inches. It has four toes on the fore limbs, and three on the hind feet, the latter furnished with long, compressed, and pointed nails; the muffle is broad and covered with a velvet-like coat of brown hair; the fur, which is soft and moderately long, is of a mottled grey colour above, and white or yellowish-white beneath; on each cheek there is a dark band; a white band crosses the muzzle and runs back on each side almost as far as the eye; the tail is dusky-brown or black.

The Viscacha lives on the Pampas from Buenos Ayres to the borders of Patagonia, and where it occurs is generally to be found in great numbers, residing in extensive burrows which it digs for itself in the ground, generally in the neighbourhood of copses, and, if possible, near cultivated fields. Each burrow has a great number of passages leading down to several chambers, in which the Viscachas live in family parties to the number of eight or ten. The Burrowing Owl already mentioned as an associate of the Prairie Dogs of North America, is found about the settlements of the Viscachas, living in their burrows, but it is said that the intrusion of these birds immediately drives out the real owners of the dwelling, as the Owls will not observe those rules of cleanliness which are characteristic of their unwilling hosts. Of course the expelled family has to make itself a new residence, and in this way great stretches of country come to be so undermined that they are dangerous to ride over. According to Mr. Darwin, the most favourite resort of the Viscachas in the neighbourhood of Buenos Ayres are those parts of the plain which, during half the year, are covered with great thistles.

They are nocturnal in their habits, passing the day sleeping in the recesses of their burrows, and coming forth in the twilight one by one, until a large and lively company is to be seen playing about the neighbourhood of their holes. When all is quiet they go in search of their food, which consists of grasses and other herbage and roots, and sometimes of the bark of trees and shrubs. In cultivated fields they may do considerable damage. While engaged in feeding, one or other of the party is perpetually on the watch, and the moment anything occurs to cause alarm, the whole of them scamper away with their tails elevated, to take refuge in their holes. In their movements they are very like Rabbits, but less active.

The Viscacha has the very singular habit of dragging all sorts of hard objects to the mouth of its burrow, where bones, stones, thistle-stalks, hard lumps of earth, dry cow-dung, and other chance articles may be found collected into a heap, frequently, according to Mr. Darwin, amounting to as much as a wheelbarrow would contain. Mr. Darwin says that he was informed that "a gentleman riding on a dark night dropped his watch; he returned in the morning, and by searching in the neighbourhood of every Viscacha hole on the line of road, as he expected, soon found it." The purpose of this accumulation of apparently useless articles by the Viscacha has never been ascertained. It has been compared to the habit of some of the Australian Bower-birds, which adorn their playing-places with bright and glittering objects.

The Chinchillas of the Andes, or Alpine Chinchillas, are much lighter and more elegant animals than their cousins of the plains; in form they more resemble Squirrels or large Dormice. Their fur is excessively soft, perhaps the softest that clothes any animal, and in all the species it is of a grey

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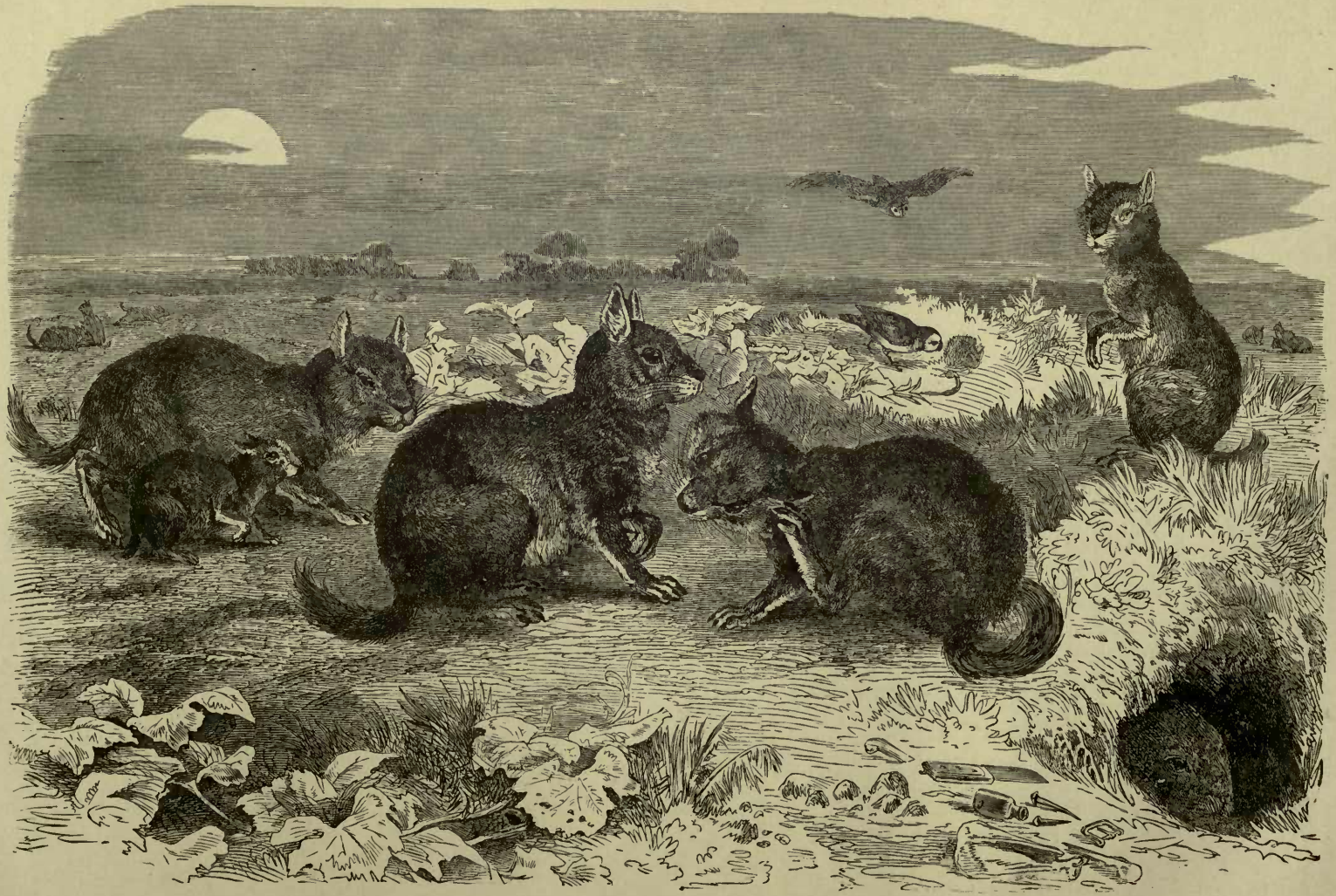
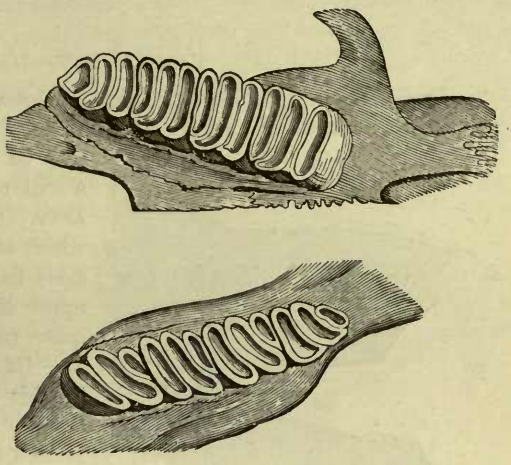


VISCACHAS.

colour, mottled or clouded with darker and lighter tints. The ears are of large size. They are confined to the Andes of Chili, Bolivia, and Peru, where they live among the bare rocks at a considerable elevation, seeking refuge in natural clefts and cavities, sleeping in their holes during the day, and coming forth at twilight in search of food. They are exceedingly lively and active in their movements, and very shy.



MOLAR TEETH OF THE CHINCHILLA.

The COMMON CHINCHILLA (*Chinchilla lanigera*), the skins of which are well known as furs, is a squirrel-like animal, nine or ten inches long, with a tail more than half this length. It has large rounded ears; its fore feet have five, and its hind four, toes. Its fur on the upper part is grey, elegantly marbled with dusky or black, on the lower surface yellowish-white; the tail is black above, and dirty white at the sides and beneath. The incisors are of a bright orange colour in front. The SHORT-TAILED CHINCHILLA (*C. brevicaudata*), a larger species, has the tail only three inches long. Its fur is of a general silvery-grey hue, tinged with black, especially along the back, and the tail has two dark bands on its upper surface. Both these animals inhabit Peru, and the former is also found in Bolivia and Chili. They are exceedingly abundant, notwithstanding the constant persecution to which they are subjected for the sake of their skins. They come out of their holes even in the daytime, but then always keep on the shady side of the rocks. Their activity is described as wonderful, and they will run with great rapidity up perpendicular walls of rock which seem to offer no hold for their feet. On the ground they are said to run very much after the fashion of our common Mice. The Chinchilla seems to breed nearly all the year round, and the female is said to produce from four to six young at a birth.

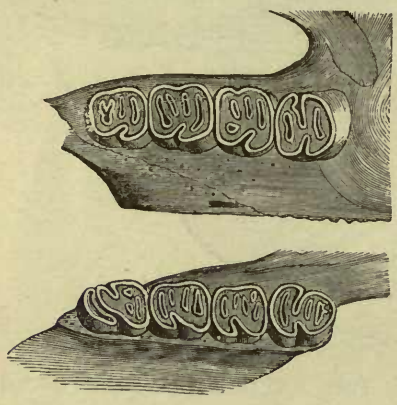
CHINCHILLA.

The other two species of Alpine Chinchillas are placed in a separate genus, characterised by a more hare-like form, longer ears, and the presence of only four toes on both fore and hind feet. CUVIER'S CHINCHILLA (*Lagidium Cuvieri*) is about eighteen or twenty inches long, of an ashy-grey colour with a yellowish tinge above, and pale yellow beneath; the tail, which, with the hair, is nearly as long as the body is clothed beneath with short black hairs, and above with much longer bushy hairs, gradually increasing in length towards the tip, where they are black; a black line passes down the middle of the tail, and its sides are dirty white. The PALE-FOOTED CHINCHILLA (*Lagidium pallipes*), which is about the same size as the preceding, but has a shorter tail, is ashy grey, with a brownish tinge, becoming yellowish fawn colour beneath. The range of these animals seems to be the same as that

of the true Chinchilla, but the second of them passes northwards into the mountains of Ecuador. In their habits they agree with the Chinchillas.

FAMILY XIV.—DASYPROCTIDÆ (AGOUTIS).

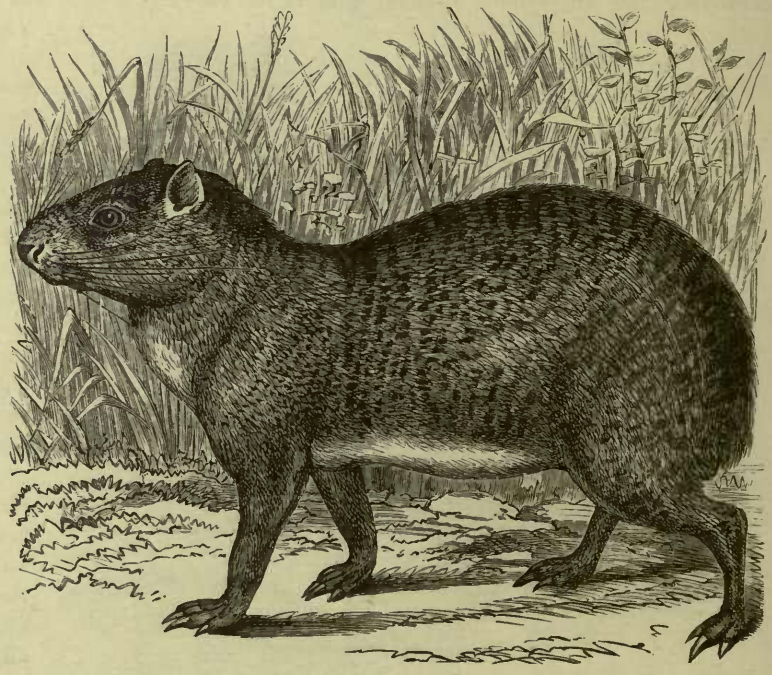
In the Agoutis we have the first of three more or less pig-like families, furnished with hoof-like nails on the toes, all the members of which are inhabitants of South America. The Agoutis especially may be compared to small slender-limbed Pigs, but they bear a still closer resemblance in external form to the little Musk Deer. The Dasyproctidæ have the incisors long; the molars, which are at first rootless, and afterwards close up, have enamel folds from both surfaces; the clavicles are rudimentary; the upper lip entire; the ears short; the tail short and naked, or quite rudimentary; and the fore feet have five toes.



MOLAR TEETH OF THE AGOUTI.

Of these animals eight or nine species are known. They inhabit South America, from Mexico southwards to Paraguay and Bolivia, and some of them also occur in the larger West Indian Islands. They frequent the forest region, and especially haunt the banks of rivers.

The AGOUTI (*Dasyprocta aguti*), the most abundant and best-known species, is found chiefly in Guiana, Brazil, and eastern Peru, where it is to be found plentifully in the primeval forests. Like the other true Agoutis, it has only three toes on the hind foot; its ears are of moderate size and rounded; its form compact, and supported upon slender limbs; its tail rudimentary; and the hair of its back is coarse and harsh, and longer towards the hinder parts, which thus obtain a somewhat truncated appearance. Its general colour is olive brown, produced by a mixture of black and yellow; but the long hairs covering the hinder portion of the back are usually of an orange colour, and the middle line of the abdomen is whitish or yellow. This animal is from eighteen to twenty inches long.



AZARA'S AGOUTI. (From the *Proceedings of the Zoological Society.*)

Although inhabiting the forests, the Agouti is not unfrequently seen on the neighbouring grassy plains, but its residence is among the trees, in the hollows of which, or in cavities at their roots, it takes up its abode, generally lying concealed in its retreat during the day. It is very quick in its movements, runs well, and springs with almost the agility of an Antelope. The food of the Agouti consists of almost any vegetable substances that come in its way. It will eat grass and herbage, the roots of plants, their flowers and fruit, and when it lives in the neighbourhood of sugar plantations

and gardens its inroads may give rise to considerable injury. The animal is, however, rather solitary in its habits, living by itself in its cell, in its departure from and return to which it appears generally to follow exactly the same roads, by which means a narrow but very distinct footpath is in course of time produced. This naturally often leads to the discovery and capture of the little recluse.

The Agouti appears to breed all the year round, usually producing two young ones at a birth. The female prepares her dwelling for the reception of her family by lining it comfortably with leaves, fine roots, and hair.

In the southern parts of Brazil, in Paraguay and Bolivia, the place of this species is taken by Azara's Agouti (*Dasyprocta Azaræ*). A smaller species, the Acouchy (*D. acouchy*), is found not only in Guiana and the north of Brazil, but also in several of the West India Islands. The last-named species has a well-developed tail about two inches long.

SKULL OF THE PACA.

Besides the Agoutis, this family includes an allied animal, the Paca (*Cœlogenys paca*), which differs generically from the Agoutis by having five toes on the hind feet. It has a broader head and a blunter muzzle, and is altogether a rather stouter animal than the Agoutis; but, like most of them, it has a mere tubercle instead of a tail. One of the most remarkable characters presented by this animal, however, is the enormous development of the zygomatic arches, which are enlarged and inflated in the most extraordinary manner, the maxillary portion, which occupies the anterior two-thirds being hollowed out beneath into a great chamber, lined with mucous membrane, and opening into the mouth by a rather small aperture. The function of these remarkable cavities is at present quite unknown. Food is not to be found in them, and, indeed, as they are enclosed by solid bone, it would seem impossible that they could act as cheek-pouches.

The Paca, which inhabits Central and South America from Guatemala to Paraguay, is about two feet long, and is clothed with short rather coarse hair of a brown or yellowish-brown colour above, white beneath, with from three to five bands of white streaks and spots upon each side

PACA.

of the body. In its habits the Paca very much resembles the Agouti. It usually lives singly, or sometimes in pairs, on the borders of the forests, or near the banks of rivers, taking up its abode during the day either in a hole at the root of some tree, or in a burrow excavated by its own labour, which is generally carried to a depth of four or five feet. Its food consists of the leaves, fruits, and flowers of various plants, and, like the Agouti, it occasionally does mischief in the corn-fields and gardens. The female produces only one, or at most two, young at a birth. The Paca swims well, and can cross even a broad river in this way. Its flesh, like that of the Agouti, is very well flavoured, and is consumed both by natives and Europeans.

FAMILY XV.—DINOMYIDÆ.

This family has been founded for the reception of a single species, of which only a single specimen has hitherto been obtained. It is described by Professor Peters under the name of *Dinomys Branickii*. In its external appearance it closely resembles the Paca (*Cœlogenys paca*), but may at once be distinguished from that animal by its possession of only four toes both before and behind. The ears are short and rounded; the upper lip deeply cleft; the incisors very broad; the molars four on each side, and divided into transverse plates by folds of enamel; the clavicles are imperfect; and the tail of moderate length and well clothed with hair. The animal, which inhabits the high mountain regions of Peru, is of the size of the Paca, or about two feet long, exclusive of the tail, which measures rather more than nine inches. Its general colour is grey, produced by the sprinkling of white among nearly black hairs; and on each side of the body are numerous large white spots, of which the upper ones nearly run together, so as to form two longitudinal bands. The extremity of the tail is black.

The only known example of this Rodent was obtained by M. Constantin Jelski at the Colonie Amable Maria, on the Montaña de Vitoc, in Peru, having been found at daybreak walking about the yard. It showed no fear of man, and was easily killed by a sword cut or two on the head. The species would appear to be rare, as the inhabitants of the neighbourhood were not acquainted with it. Of course nothing is known of its habits.

THE DINOMYS. (*After Peters.*)

The chief interest at present attaching to this animal, therefore, consists in its peculiar combination of characters. Externally, as already stated, it resembles the Paca, with which it also agrees in the S-like form of the nostrils, and in the structure of the limbs (except the number of toes). In the lamellar structure of the molar teeth, in the structure of the skull, and of the skeleton generally, and especially in the flattened form of the front of the sternum and the development of clavicles, it differs from the Paca and all other Rodents with hoof-like nails. In some minor particulars it resembles the Capybara. By the structure of the molar teeth and certain osteological characters, it is most nearly allied to the Chinchillas; while it approaches the genus *Capromys* among the Octodontidæ in

the structure of the limbs and of some other parts of the skeleton. Professor Peters is evidently inclined to regard it as most nearly related to the Chinchillidæ, but as constituting a group establishing a closer union than previously existed between the families Chinchillidæ, Octodontidæ, Dasyproctidæ, and Caviidæ.

FAMILY XVI.—CAVIIDÆ (CAVIES).

This family, the last of the simple-toothed Rodents, includes a small number of species, of which the Common Guinea-pig may serve as a sort of type. The Guinea-pig is, however, one of the smaller species of the family, and is shorter in the limbs than most of its relatives. They have the incisor teeth short, that is to say, not extending far back in the jaw; the molars are rootless, variously divided by folds of enamel into lobes, the angles of which are acute; the palate is narrow in front, so that the upper series of molars approach each other rather closely in front; the clavicles are rudimentary or wanting; the fore limbs have four and the hind feet only three toes, all armed with hoof-like nails; the upper lip is not cleft; and the tail is rudimentary or wanting. They are stout, more or less rabbit-like animals, with a soft coat, and the ears variable in length; and they are confined to the continent of South America, where they chiefly inhabit the plains.

The Restless Cavy (*Cavia aperea*), which is commonly regarded as the wild original of the so-called Guinea-pig (*Cavia cobaya* of some authors), is abundant on the banks of the Rio de la Plata, and extends thence northwards through Paraguay into Bolivia and Brazil. It is usually about nine inches long, with the fur of the upper part and sides of the body composed of a mixture of black and dingy yellow hairs, the chest greyish-brown, and the throat and belly pale dingy-yellow or brownish-grey. The incisor teeth are white. The genus to which this animal belongs may be at once distinguished from the other two genera constituting the family by the shortness of the limbs; the ears also are short; the feet are naked beneath; the hind toes are not webbed; and the molar teeth are nearly equal in size, and each composed of two angular lobes.

The specific name of the Restless Cavy seems to be derived from its popular name in the country where it occurs. According to Mr. Darwin, it is very common about the banks of the La Plata, sometimes frequenting sandy hillocks, and the hedge-rows formed of the agave and the prickly pear, but apparently preferring marshy places covered with aquatic plants. In dry places it makes a burrow; but when it frequents wet localities contents itself with the concealment afforded to it by the herbage. Rengger describes it also as generally haunting moist situations in Paraguay, and he adds that it keeps near the borders of forests, but is never found either in the forests or in the open fields. It lives in small societies of from six to fifteen individuals, in the impenetrable thickets of Bromelias, where its presence is revealed by the numerous beaten paths which it produces by going to and fro. In Bolivia, according to Mr. Bridges, it is peculiar to the low lands, and there takes shelter among the loose stones of the walls enclosing the fields. It is active in search of food early in the morning and in the evening, but will also come forth on gloomy days. Rengger and Azara both agree in the statement that the female produces only one or two young at a time; but the former says that this takes place only once in the year, whilst the latter describes the animal as breeding all the year round, and, indeed, in this way accounts for its abundance, notwithstanding its being preyed upon so extensively by rapacious birds and quadrupeds.

The question whether our common Guinea-pig is really the domesticated descendant of the animal just described can hardly be regarded as finally settled, and, indeed, independently of colour, there are sufficient differences between them to justify some doubt on the subject. The name Guinea-pig may, as Mr. Waterhouse suggests, be a mistake for Guiana-pig, and the first specimens may very probably have come from that part of America. Its prevalent colours, as is well known, are combinations of white, black, and yellow, and as these colours are shown in the drawings of Aldrovandus, dating back to within fifty years of the discovery of South America, there seems every reason to believe that the animal must have been long domesticated in America prior to its introduction into Europe. On the other hand, Dr. Rengger says that he saw fourteen Apereas representing the fifth or sixth generation from a single couple domesticated about seven years before, and that these exhibited no

difference of colouring from the wild animal. Several allied species inhabit the great plains of South America.

The Bolivian Cavy (*Cavia boliviensis*), which is grey in colour, with a faint yellowish tinge, with the throat and belly white, the feet whitish, and the incisor teeth orange yellow, inhabits the elevated parts of Bolivia, generally at a height of 10,000 or 12,000 feet. The Rock Cavy (*Cavia rupestris*) is found in rocky districts in Brazil, where it shelters itself in holes and crevices. It is always found near the upper waters of rivers, and is a large species, measuring thirteen or fourteen inches in length. The Southern Cavy (*Cavia australis*), on the other hand, is a small species which inhabits Patagonia, where it ranges from 39° S. lat. to the Strait of Magellan.

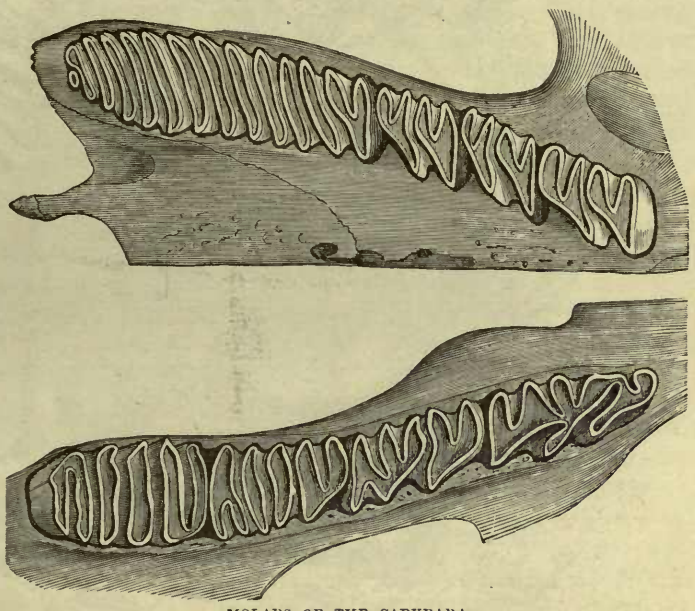
This part of the world is also the abode of another and much larger species of the family, the Patagonian Cavy or Mara (*Dolichotis patachonica*), an animal which somewhat resembles the Agouti in the length and comparative slenderness of its legs, and differs from all other Cavies in having tolerably long, pointed ears. It also possesses a very short tail. The molar teeth are rather small, and resemble those of the Guinea-pig in being formed of two nearly equal angular lobes, but the last molar in the upper jaw, and the first in the lower jaw, have three such lobes. The animal is somewhat Hare-like in its appearance, and has been mistaken for a Hare by superficial observers. It is, however, a much larger animal, measuring from thirty to thirty-six inches in length, and weighing from twenty to thirty-six pounds.

PATAGONIAN CAVY.

The Patagonian Cavy is clothed with a dense crisp fur of a grey colour on the upper part of the head and body, rusty yellow on the flanks, and white on the chin, throat, and belly; the rump is black, with a broad white band crossing it immediately above the tail. It inhabits Patagonia about as far south as 48°, and extends northwards into the La Plata territory as far as Mendoza. It is found only in the sterile desert part of the country, where the gravelly plains are thinly covered with a few stunted thorny bushes and a scanty herbage. The northern limit of the species, according to Mr. Darwin, is at the point where the vegetation of the plains becomes rather more luxuriant. The Patagonian Cavy usually burrows in the ground, but where it lives in the same region as the Viscacha, it will take advantage of the excavations made by that animal. It wanders to considerable distances from its home, and on these excursions two or three are usually seen together. Mr. Darwin says:—"It is a common feature in the landscape of Patagonia to see in the distance two or three of these Cavies hopping one after the other over the gravelly plains." Their mode of running, on the same authority, more nearly resembles that of the Rabbit than of the Hare; though their limbs are long, they do not run very fast. They rarely squat like a Hare, but are very shy and watchful, and feed by day, in connection with which it is to be observed that the eyes are defended from the direct rays of the sun by well-developed eyelashes, which do not occur in the other Cavies. The female produces generally two young at a birth, which are brought forth and suckled in the burrow.

The Capybara (*Hydrochœrus capybara*), the only other member of the present family, is the largest of all existing Rodents, large specimens measuring over four feet in length. It is a stout-built and massive animal, with limbs of moderate length, a large head with a very blunt muzzle, small

eyes and ears, no tail, and both the fore and hind feet webbed. The upper incisor teeth have a broad and shallow groove down the front, and the molars present very remarkable characters. In the upper jaw the first three molars are each composed of two lobes united by cement, and on the outside of each of these lobes there is a fold of enamel which passes deeply into the tooth. The last molar consists of one lobe similar to those of the preceding teeth, but in place of the second there are ten or a dozen transverse plates. The first two molars of the lower jaw exhibit complex lobes and folds of enamel; the third and fourth a combination of folded lobes and transverse plates.



MOLARS OF THE CAPYBARA.

In its general form the Capybara is more pig-like than any of its relatives, and, indeed, its generic name, *Hydrochœrus*, Water-pig, recalls this resemblance, and at the same time intimates its aquatic habits. Its coat is composed of long and coarse hairs, often five or six inches long on the hinder parts, of a reddish-brown colour above, and a dirty brownish-yellow beneath. It is distributed over the whole eastern part of South America, from Guiana southwards to the Rio de la Plata, and ranges westwards into the lower parts of Peru and Bolivia.

The Capybaras frequent the borders of the lakes and rivers, with which all this part of the South American continent abounds, and, according to Mr. Darwin, they used to frequent the islands in the mouth of the La Plata, where the water is quite salt. In this part of America they are called "Carpinchos." They never wander far from the water-side, and show a marked preference for the larger rivers, among the reeds and other plants fringing which they take up their abode. In populous districts they seem to pass the day in concealment, coming forth in search of food only at morning and evening, but where they are less in danger of pursuit they come out freely in the day-time. Seen from a little distance when walking they have much the appearance of Pigs, but they lose this when they sit, like the other Cavies, on their haunches. When danger threatens they emit a short, sharp bark, and immediately plunge into the water, where they swim about with little more than the nostrils above the surface; but under pressing circumstances they can dive and swim for a considerable distance under water. When swimming, the female is said to take her young ones on her back. About Maldonado Mr. Darwin observed that the Capybaras were usually to be seen only three or four together, but they are more numerous and go in larger companies more in the interior of the country. They constitute the ordinary food of the Jaguar, and are also eaten by the Indians, although their flesh is said not to be very good. The female produces five or six young at a birth, but has only one litter in the year. The young follow their mother about at a very early age.

SUB-ORDER II.—DOUBLE-TOOTHED RODENTS.

With the Cavies concludes the long series of simple-toothed Rodents, and some of them, as we have seen, present no small resemblance to the Hares and Rabbits which constitute the greater part of the second great group into which we have divided the order. The chief peculiarity of this section, as has been already stated, consists in the presence in the upper jaw of a pair of minute incisor teeth, placed immediately behind the large effective incisors; and in the newly-born animal the number of these teeth is even greater, there being six incisors in the upper jaw, two of which fall

CAPYBARA.

out at an early period. Though the number of species included in this section is very considerable (about fifty, according to Mr. Wallace's estimate), it includes only two families, and each of these contains only a single genus. We will commence with that which includes the best-known forms, the Hares and Rabbits.

FAMILY XVII.—LEPORIDÆ (HARES AND RABBITS).

The general appearance of these animals hardly needs to be described, and we may, therefore, indicate merely the structural peculiarities which serve to define the family. These consist in the presence of six rootless molars on each side in the upper, and five in the lower jaw (*see* figure on p. 82), each molar being divided into lobes by transverse folds of enamel; in the compressed form of the skull and the presence of wing-like post-orbital processes of the frontal bones; in the imperfect condition of the clavicles; the greater development of the hind limbs; and the presence of a short, bushy, upturned tail. The ears are long; the inner surface of the cheeks is more or less clothed with short hairs; the fore-limbs have five, and the hind-limbs only four toes; and the soles of the feet are hairy throughout. In all these characters, however they may differ in some respects, all the true Hares and Rabbits agree. The representatives of this family occur in nearly all parts of the world, but chiefly in the northern hemisphere, and the few species which pass down within the tropics are generally found only in mountainous regions. In the north they reach the Arctic regions in both continents. In the Old World a few species are scattered over India and Further India, and four or five occur in Africa, but chiefly in the southern part of the continent. In North America the species are numerous, and some of them range southward into Central America; but South America has only a single species, which occurs in the mountains of Brazil and upon the Andes.

As the whole of the family consists of animals to which in common parlance the names of Hares and Rabbits are given, we may take as examples of it the Hares and Rabbits which are so abundant in Great Britain, the other species agreeing generally with one or other of them in character and habits.

They may all be characterised as animals destitute of any means of defence against their enemies, except the rapidity of their movements, and as exceedingly shy and timid. Their general colour is a mixture of grey and brown, sometimes quite tawny, sometimes almost pure grey, and, as Mr. Bell remarks, "The admirable wisdom which has assigned such colours to a group of defenceless animals which conceal themselves amidst the brown sombre vegetation of woods and heaths, will appear more striking when it is recollected that certain species inhabiting the snowy regions of the north become wholly white in winter. All the members of the genus," he adds, "are remarkable for their timidity, and their whole structure is such as at once to announce to them the presence of danger, and to enable them to escape from it. The eyes and ears are so formed and situate as to become instantly cognisant of even distant warnings of peril, and the limbs are admirably adapted for the most rapid flight."

This last statement applies in a special manner to the Common Hare (*Lepus europæus*), which is singularly well adapted for getting over the ground rapidly by the great length and powerful development of its hind legs. These organs are nearly twice as long as the fore limbs, and, as most of us are well aware, the bones composing them are set in motion by an enormous mass of solid muscle. Owing to their great preponderance the Hare, when moving slowly in search of food, goes with a sort of lolloping gait; but the moment there is occasion for him to move with rapidity, the disproportionate hind limbs stand him in good stead, and he shoots along over the ground by a series of long leaps, and with great swiftness. At the same time, it is observed that the length of its hind legs causes the Hare to run with much greater facility up hill than down, and, in fact, it is said that in descending steep inclines the animal is obliged to run obliquely in order to escape over-balancing itself. When pursued, the Hare has the art of making sudden turns in its course, known as "doubles" or "wrenches," by which the Dogs in chase of it are thrown out, for although most Greyhounds are swifter of foot than a Hare, they are incapable of changing their course so sharply, and thus, while they are carried some distance onwards by their own impetus, their intended victim is making off in a different direction. They adopt other cunning artifices in order to escape from their pursuers, and some of these indicate a considerable amount of intelligence. Under such circumstances, and also in search of a more plentiful supply of food, the Hare will take to the water readily, and swim across rivers. Mr. Yarrell observed a Hare even swimming across an arm of the sea about a mile broad.

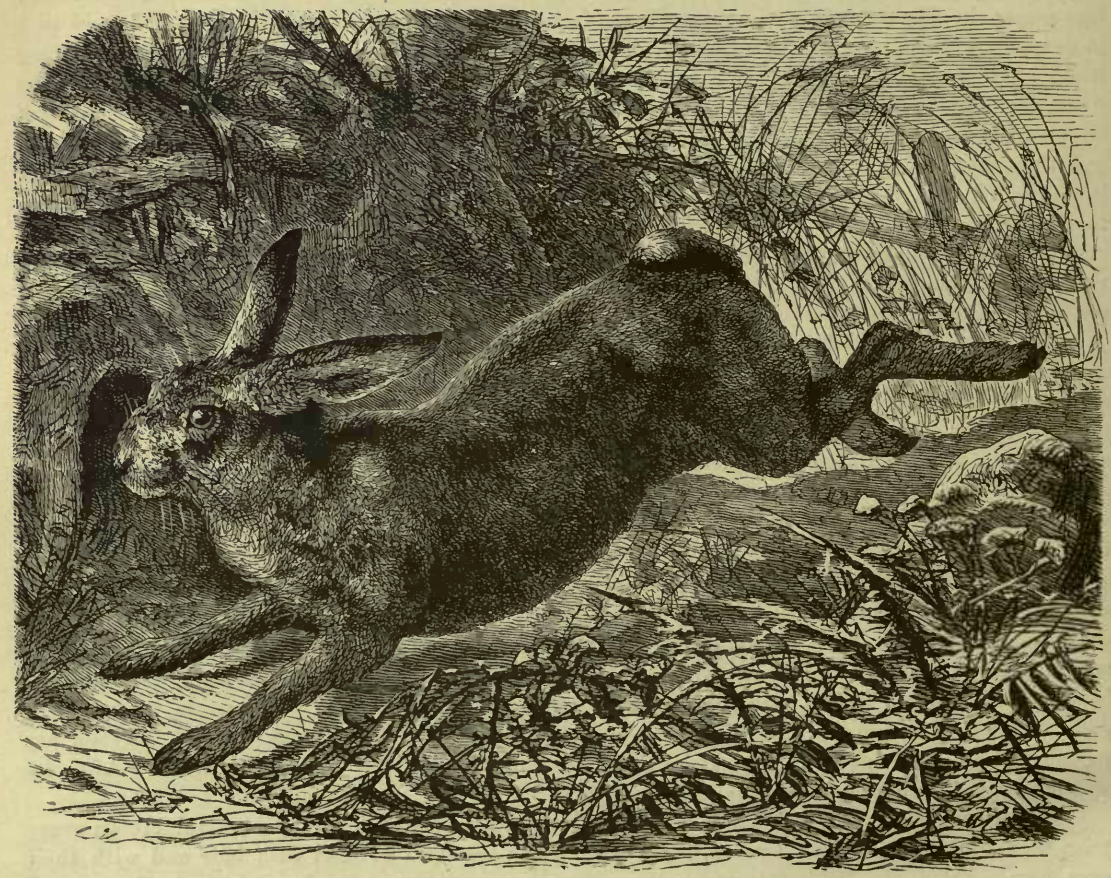
The Hare lives chiefly in cultivated fields, where it resides in a small depression of the surface, which is called its "form." It shifts the situation of this simple residence according to the season, selecting a shady spot in summer, and a sunny one in winter, and going into cover in wet weather. It is rather a nocturnal or crepuscular than a day-feeding animal, although it may not unfrequently be seen abroad in the day. In the evening and early in the morning it is most active, passing the brighter hours at rest in its form. When out in the field in search of food it goes hopping along among the herbage and cultivated plants, every now and then sitting upright on its haunches and listening with erected ears for the slightest sound indicative of approaching danger. Its food is exclusively of a vegetable nature, but it seems to embrace pretty nearly the whole round of cultivated plants. Cruciferous plants appear to be amongst its favourite articles of diet, but it also does much damage to fields of young wheat. In the winter, when the open fields are covered with snow frozen hard, and, indeed, sometimes in the summer, the Hare will make his way into gardens in search of food, or, if this resource is not at hand, into plantations of young trees, where it will gnaw off and feed upon the bark, thus destroying great numbers of the trees. Mr. S. Mawson has recorded finding the stomach of a Hare killed in winter filled with hawthorn berries. After its wanderings the Hare always returns to its own form.

Hares pair when they are about a year old, and from that time produce several broods every year, each consisting of from two to five young, which are born covered with hair and with their eyes open. From Mr. Bell's statement, these animals would appear to breed almost all the year

round; he says that in mild winters young Hares have been found in January, and that he has known breeding continue till the middle of November. When captured young, the Hare may be easily tamed, and become an amusing pet, as, indeed, will be familiar to almost every one, through Cowper's account of his Hares. Formerly the Hare used to be trained by jugglers to perform various tricks, one of which was the beating of a tambourine with its fore-feet, with which the animal will of its own accord drum upon the back of an offending companion. A relic of this practice is to be recognised in a common toy, which shows a small Hare sitting and beating a tambourine, its fore limbs being set in motion by the turning of the wheels of its stand.

The Common Hare is found spread over the greater part of Europe, from the south of Sweden and northern Russia to the Mediterranean and the Caucasus. It does not occur in Ireland. It varies somewhat in colour in different localities, and although it does not become white in winter, the northern forms show a tendency in that direction, and the others acquire a greyish tint at the approach of the cold weather.

The Rabbit, or Cony (*Lepus cuniculus*), differs from the Hare in various characters; its colour is a tawny brownish-grey, the disproportion between the fore and hind limbs is not so great, and the ears are shorter, not exceeding the head in length. Although the Wild Rabbit is so plentiful in England as to become a pest to the farmers in many places, it is supposed not to be a native of north-western and central Europe, but to have been naturalised in Britain, its original home being in the countries bordering the Mediterranean. It is, and always was, very abundant in Spain, the name of which country (Hispania) has been supposed to mean the "country of Conies," from the Phœnician and Hebrew word *Schaphan*, the name of the Hyrax or Cony of the Bible. Even in the present



COMMON HARE.

day it is very local in its distribution north of the Alps, and is not found at all in eastern and northern Europe. In Australia it has proved to be a veritable scourge.

In its habits the Rabbit differs from the Hare more than in its form and structure. Instead of contenting itself with a shallow depression as a resting-place on the surface of the ground, it digs deep holes in the ground, into which it may retire to sleep or at the approach of danger. It prefers light sandy soils for its residence, as these present great facilities for burrowing, and wherever particularly favourable conditions exist the Rabbits are to be found living together in very large societies. Furzy heaths are favourite places with them, as the ground is easily worked, and the furze bushes not only serve as a protection to the burrows, but furnish the Rabbit with an abundant supply of food, the young shoots being eaten off as high as the animals can reach when standing on their hind feet. In wet moors the Rabbits avoid burrowing, and live in runs and galleries formed in the matted heather and long herbage. Mr. Bell says that in more than one instance he has known a family to take possession of a hollow tree, ascending its inclined and decayed trunk for some distance.

Like the Hare, the Rabbit is generally quiet during the day, although it will not unfrequently be abroad at all hours. The evening, however, is its principal time for activity, and then the inhabitants of the warren may be seen playing about near their abodes, or wandering to greater distances in search of the green vegetables on which they feed. The moment there is the smallest suspicion of danger, the whole company scamper off at once to seek safety in their burrows. As they go, their white tails are the most conspicuous objects to be seen, and the spectacle of some hundreds of them rushing along at full speed, vanishing one after the other down the burrows, is lively and amusing enough.

The Rabbit begins breeding at six months old, and has several litters in each year. The young are usually from five to eight in number, sometimes even more; they are born blind and naked, and are produced in a separate burrow which the female digs for their reception, and lines with fur pulled from her own body. This brood-chamber has usually only a single entrance, and this the mother closes with earth after visiting and suckling her young family, which she is said to do only at night.

When domesticated, the Rabbit, as is well known, differs materially from its wild state. It is larger, and its colours are usually white, black, brown, or fawn colour, sometimes alone, sometimes mixed in patches. Albinoes are common, and form a permanent race. The Angora Rabbit, which is usually albino, has the hairs very long; and the so-called "fancy Rabbits" have the ears more or less pendent at the sides of the head, and often so long as to touch the ground.

A third British species is the Mountain Hare (*Lepus variabilis*), or Northern Hare, an inhabitant of all the northern parts of both hemispheres, which occurs in most parts of Scotland, and in Ireland, where, indeed, it takes the place of the common Hare. In its summer coat it is of a light fulvous grey colour, and is further distinguished from the common Hare by the shortness of the ears and tail, the former being shorter than the head, and the latter little more than half its length. In cold climates this animal becomes pure white in the winter. This Hare is absent from Central Europe, but reappears on the chain of the Alps.

It will be unnecessary to enter into details with regard to the other species of this family, all of which more or less resemble those just described, both in appearance and habits. They are distributed over nearly the whole world except the Australian region, but they are most numerous in North America, where a great many species have been described, which are reduced by Mr. Allen to twelve. Four of these, however, present well-marked local races, which double the number of recognised permanent forms.

FAMILY XVIII.—LAGOMYIDÆ (PIKAS).

In many respects the Pikas closely resemble the Hares, but they are distinguished by having only five molars on each side in each jaw, a depressed skull, with contracted frontal bones destitute of the wing-like process seen in the Hares, complete clavicles, short ears, limbs nearly equal in length, and no tail visible externally. They are much smaller than any of the Leporidæ, the largest being no larger than a Guinea-pig, to which the animals have some resemblance; while in their habits they somewhat resemble the Marmots. When feeding they often produce a chirping or whistling noise, whence the name of Piping Hares, or Calling Hares, has been applied to them. Ten or a dozen supposed species of these animals have been described, most of them

inhabiting the northern and mountainous parts of Asia, and one of these is also found in Europe, about the southern part of the Volga. In Asia species have been found as far south as the Himalayas and Nepaul. In North America a single species (*Lagomys princeps*) inhabits the Rocky Mountains, where it was first discovered by Sir John Richardson.

The Alpine Pika (*Lagomys alpinus*), which inhabits Siberia from the Irtish eastwards into Kamtchatka, is a little animal from nine to nine and a half inches long, of a greyish-brown colour above, yellowish-grey beneath; the feet are pale, and the ears dirty yellowish-white within, becoming dusky towards the margin, which is white. This animal occurs in considerable numbers in the Alpine and sub-Alpine parts of Siberia, where it either burrows in the ground, or shelters itself in crevices of rocks or among loose stones. The Pikas generally come out only at night, although they sometimes venture forth on a cloudy day. Their food consists of the scanty herbage to be found in their elevated abode, and as this would be impossible to procure during the winter when the ground is thickly covered with snow, the Pikas take care in the autumn to collect a large supply of dried grasses and other herbage, which they pile up near their habitations like little haystacks. They are, however, sometimes deprived of the fruits of their labour by the Sable-hunters, who plunder the Pikas' stacks to feed their Horses. The female produces about six naked young early in the summer.

ALPINE PIKA.

The Rocky Mountain Pika (*Lagomys princeps*) is a small species from six inches to seven and a half inches long, of a greyish-brown colour above, yellowish-brown on the sides, and greyish below. It received its specific name from its discoverer, Sir J. Richardson, in allusion to the name of "Little Chief Hare" given to it by the Indians. It inhabits the summits of the Rocky Mountains from Colorado northwards far within British America, and also occurs in the mountains of Utah, California, and Oregon. Mr. Allen describes its habits as follows:—"The animals are everywhere found in communities, living among the loose rocks from a little below timber-line nearly up to the snow-line. They appear to rarely wander many yards from their homes; are timid, yet easily become familiar. Though retreating to their homes when first alarmed, they soon come cautiously out one after another, till one may hear their sharp little cries in every direction. Their colour so nearly resembles that of the rocks they live among, that they are not easily seen, and their cry is of such a character as easily to mislead one in respect to the point from which it proceeds, seeming to be far away when only a few feet distant. They sit erect, like little Marmots. . . . They carry into fissures of the rocks large quantities of grass, which they lay up for winter consumption."

CHAPTER V.

FOSSIL RODENTIA.

Families of Rodent, represented by Fossil Remains—State of the "Record of the Rocks"—THE SCIURIDÆ—Sciurine Genera now Extinct—No Fossil ANOMALURIDÆ and HAPLODONTIDÆ—ISCHYROMYIDÆ—*Pseudotomus hians*—*Gymnoptychus*—CASTORIDÆ—Mr. Allen's CASTOROIDIDÆ—THE MYOXIDÆ—No Fossil LOPHIOMYIDÆ—THE MURIDÆ—THE SPALACIDÆ—THE GEOMYIDÆ—THE DIPODIDÆ—THE THERIDOMYIDÆ—THE OCTODONTIDÆ—THE HYSTRICIDÆ—THE CHINCHILLIDÆ—THE DASYPROCTIDÆ—THE CAVIIDÆ—THE LEPORIDÆ—THE LAGOMYIDÆ—*Mesotherium cristatum*—Difficulties concerning it—Mr. Alston's Suggestion—THE HEBETIDENTATA—Teeth—Skull—Skeleton—Conclusions regarding it—Table of Rodent Families—Concluding Remarks.

THE majority of the preceding families are more or less clearly represented by fossil remains, either in the younger strata of the earth's crust, or in those cave-deposits of comparatively recent date which have furnished so many interesting relics of the Mammals of former days. It must be remarked, however, that while a considerable number of fossil Rodents have been named and described by palæontologists, the materials upon which many of them have been established are very imperfect; in a great number of cases isolated molar or even incisor teeth furnish the sole evidence of the existence of creatures which were manifestly Rodents, but of which the other characters are rather difficult to divine from such scanty material. Still, imperfect as may be "the record of the rocks" in this as in other instances, it is in some parts sufficiently complete to enable us to trace back the existence of many forms of gnawing Mammals through a long period of geological time.

Of the SCIURIDÆ a considerable number of fossil species have been recorded. Species of the genera *Sciurus*, *Arctomys*, and *Spermophilus*, some of them identical with those still existing, have left their remains in Post-Tertiary deposits and in bone-caves in various parts of Europe; while species belonging to the first two genera, and to the American genus *Tamias*, have been detected in similar situations in North America. A few forms referred to the same genera go down still lower in the series of geological formations. True Squirrels are recorded from Miocene and Upper Eocene deposits in France, and a single species from the Tertiaries (probably Miocene) of Colorado; Marmots from Pliocene and Miocene beds in the South of France, and from a Pliocene deposit in Nebraska; and a Spermophile from the Miocene of Weisenau in Germany.

Besides these examples of known types, several fossils have been obtained both in Europe and America, which are regarded as indicating genera distinct from any now living. *Plesiarctomys Gervaisii* is founded on a fragment of jaw with four molars, obtained from Upper Eocene beds near Apt, Vaucluse. In its characters it appears to be intermediate between Squirrels and Marmots. *Pseudosciurus suevicus*, from the Upper Eocene (Bohnerz) of Würtemberg, seems to differ from all other Sciuridæ in the form of the molar teeth of the lower jaw, which are somewhat elongated, and have four tubercles arranged in two pairs, each pair being connected by a ridge. From the Tertiary deposits of the western territories of the United States, Professors Cope, Marsh, and Leidy have described several Sciurine Rodents as belonging to genera now extinct: thus *Paramys* has five species; *Sciuravus* (perhaps identical with the preceding), three; *Heliscomys*, *Mysops*, *Colonymys* *Taxymys*, and *Tillomys*, one or two species each.

Of the ANOMALURIDÆ and HAPLODONTIDÆ no fossil remains are known. On the other hand, a North American fossil Rodent, described by Dr. Leidy under the name of *Ischyromys typus*, is regarded by Mr. Alston as the type of a distinct family, the ISCHYROMYIDÆ, nearly allied to the Sciuridæ, but also showing an affinity to the Beaver in some of its characters. The specimen described and figured by Dr. Leidy was obtained by Dr. Hayden from Miocene deposits in the "Bad Lands" of Wyoming. It was originally referred to the Sciuridæ, with which it agrees in its dentition, but is distinguished by its large infra-orbital opening, the presence of a sagittal crest, and the absence of post-orbital processes. The parietal region of the skull is much narrowed, and in this, as in the large size of the infra-orbital opening, *Ischyromys* resembles the Musk Rat.

Two other forms must be referred to here. Under the name of *Pseudotomus hians*, Professor Cope has described the remains of an animal which he believed to have been about the size of an Agouti, and originally thought to belong to the order Edentata. Subsequently he referred it to the Sciuridæ; but both Mr. Alston and Mr. Allen think that it may belong to the family Ischyromyidæ. In some

respects the skull resembles that of *Arctomys*, but it has the same contraction between the orbits as *Ischyromys* and *Fiber*. The incisor teeth are separated, and Professor Cope believes that the animal had only three molars on each side in each jaw. A still more doubtful member of the family is Professor Cope's genus *Gymnoptychus*, which includes four species, all said to be from the "Tertiary of the Plains." In this genus there are five molars above and four below on each side, as in *Ischyromys* and the Sciuridæ; but these teeth show two crescents on the inner side in the upper, on the outer side in the lower jaw, and each crescent gives origin to a cross-ridge running to the opposite margin of the tooth.

The CASTORIDÆ, including at present only a single species common to the northern parts of both hemispheres, are represented by several peculiar fossil forms. Remains of the Common Beaver (*Castor fiber*) are not uncommon in peat bogs and other late superficial deposits both in Europe and America; and, according to Sir R. Owen, in association with those of the Rhinoceros, Mammoth, and Mastodon, even in the Fluvio-marine Crag (Newer Pliocene) of Norfolk. In Belgium its bones have been found in caves. Among the Mammals from the Upper Tertiaries of the Sivalik Hills, Messrs. Falconer and Cautley record a Beaver distinct from the existing species, although nearly allied to it. The skull of a great Beaver, one-fifth larger than that of the living species, was obtained many years ago by M. Fischer from sandy deposits on the shores of the Sea of Azov, and, as it differed in some peculiarities of the teeth from *Castor fiber*, was described by him as constituting a distinct genus under the name of *Trogontherium Cuvieri*. It is now regarded as a true Beaver, and named *Castor Trogontherium*. The British species, described and figured by Sir R. Owen from the Norfolk Forest bed under the name of *Trogontherium Cuvieri*, is, however, quite distinct, and belongs to the genus *Diobroticus*, characterised by having the third upper and first lower molar teeth with four enamel folds, and the rest only with two, most of the folds soon becoming isolated as the teeth wear down. This animal must have been nearly twice the size of the European Beaver.

At a still earlier period—namely, in the Miocene—the family Castoridæ was represented, both in Europe and America, by some small species, nearly agreeing with the Beavers in dentition, but differing in the characters of certain bones of the skull. These form the genus *Steneofiber*. The largest (*S. viciacensis*), from the Miocene of the Allier, was about half the size of the Beaver; another (*S. sansaniensis*), from the fresh-water limestone of Sansan, was about as large as a Rat; an American species (*S. nebrascensis*), from the "Bad Lands" of Dakota, was rather smaller than a Marmot, and presented some resemblance to the Agoutis in the characters of the teeth; and a fourth species (*S. pansus*) occurs in the Santa Fé marls. *Eucastor tortus*, a species rather smaller than a Marmot, is described by Dr. Leidy as very nearly related to the Beaver. Its remains were found in loose sands of the Niobrara River, Wyoming. *Chalicomys* and *Palæomys* are genera doubtfully placed here. Their species occur in the Miocene and Pliocene of Europe.

Some bones of a gigantic Rodent, indicating an animal as large as a full-grown Black Bear, obtained from Quaternary and Alluvial deposits of various parts of the United States, have been described under the name of *Castoroides ohioensis*, Mr. J. W. Foster, its first describer, having an idea that it was a great Beaver. It has generally been known as the "Fossil Beaver" of North America, but several authors have entertained doubts of the correctness of this designation, and Mr. Allen has lately made it the type of a special family, CASTOROIDIDÆ, which he regards as most nearly related to the Chinchillidæ. In the general aspect of the skull it resembles the Beaver, but in several details of structure approaches the Viscacha; while the structure of the molar teeth, which consist of a series of plates of dentine, completely enclosed by enamel, and held together by a thin coating of cement, occurs elsewhere only in the Chinchillidæ, and in the last molar of the Capybara.

Dormice as well as Squirrels disported themselves in the Tertiary woods and thickets of Europe, and remains of several species of MYOXIDÆ occur in various deposits in France, Switzerland, and elsewhere, from the Upper Eocene onwards. *Myoxus glis*, the Garden Dormouse, has been identified with some doubt from the caves of Lunel Viel; and this is also probably the species occurring in the Belgian bone-caves, and described as *Myoxus priscus* by Dr. Schmerling. A species a little larger than the Dormouse occurs in Russian caves, and has received the name of *Myoxus fossilis* from M. Fischer; and the most striking species of all is also a Post-Pliocene form, namely, the gigantic Dormouse of Malta (*M. melitensis*). This animal, which seems to have been about the size of a

Guinea-pig, must have been excessively abundant in Malta, for its describer, Professor Leith Adams, says that "its remains are met with in abundance throughout the cavern and fissure deposits, up even to the superficial alluvium now in course of formation." From older times we have evidence of the existence of a Dormouse, about the size of the common species, at the time of the deposition of the gypsum of Montmartre (Upper Eocene), in which a well-preserved skeleton of the animal has been found. The same deposit has furnished traces of a second rather larger species. The Miocene of Switzerland and of Sansan has also yielded species of *Myoxus;* and Professor Hermann von Meyer has recorded a Dormouse from the Miocene of Weisenau, under the name of *Brachymys ornatus.*

No fossil LOPHIOMYIDÆ have yet been detected, but the great family MURIDÆ has left abundant evidence of its former existence. Species of the genera *Mus*, *Arvicola*, *Myodes*, and *Cricetus*, identical in many cases with those now living, have been obtained frequently in Post-Pliocene deposits and in bone-caves in Europe. Lemmings (*Myodes lemmus* and *torquatus*) are recorded from English caves. The genus *Mus* is also represented by several species in the Miocene deposits of France, and in the Sivalik beds investigated by Falconer and Cautley. The Miocene of Sansan has furnished a form which has been doubtfully regarded as a Gerbille, and named *Meriones Laurillardi.* In the same and other deposits of the same age in South-eastern France several species of an extinct genus (*Cricetodon*) have been obtained. Their dentition resembles that of the Hamster, but the first molars in both jaws have a tubercle less; the largest species (*C. sansaniensis*) rather exceeded the Hamster in size, while the smallest was less than a Mouse. Associated with some of these are two doubtful forms, *Decticus* and *Elomys*, the latter considered by M. Aymard, its describer, to be allied to *Hydromys.* The American fossil Muridæ are for the most part either species of the genus *Hesperomys*, or nearly related to it. Twelve species of that genus were obtained by Dr. Lund from the Brazilian bone-caves, but of these eight were identified by him with species still existing. In North America two species of a nearly-allied genus (*Eumys*) have been obtained from Miocene deposits; and the bone-caves of Pennsylvania furnish the remains of a species of *Neotoma* (*N. magister*), hardly distinguishable from the Florida Rat.

A *Rhizomys* from the Sivalik deposits of North-western India is the only recorded fossil representative of the SPALACIDÆ; and of the GEOMYIDÆ the only known species are a *Geomys* from the Pliocene of Nebraska, nearly allied to, if not identical with, the living *G. bursarius;* and one from the "Tertiaries of the Plains," described by Professor Cope as *Colotaxis cristatus*, which, however, has only three molars in the lower jaw.

The DIPODIDÆ are still more scantily represented. A Jerboa described by M. Fischer from Post-Pliocene deposits, probably of Tartary, is very nearly allied to the living *Dipus platurus*, but has shorter toes and broader cannon-bones. The genus *Dipoïdes*, from the "Bohnerz" of Würtemberg, is founded on a single tooth, and its position in this family is very doubtful.

On the other hand, some fossil allies of the Dipodidæ and Geomyidæ constitute a distinct family, for which Mr. Alston proposed the name of THERIDOMYIDÆ, from that of one of its genera, *Theridomys.* In this genus, of which six species are recorded from the Eocene and Miocene deposits of France, there are four rooted molars in each series, and each of these has several enamel folds, some of which are converted into isolated loops as the crown is worn away. The best known species is *Theridomys platiceps*, from the Miocene of Caylus. In *Archæomys chinchilloides* there are still four molars, but these present a very different structure; they are rootless, and have the enamel folds extending diagonally across the crown, so that they are composed of a series of plates, thus presenting a certain amount of resemblance to the Chinchillas, which American family *Archæomys* was at one time supposed to represent in Europe. In fact, in the structure of their molar teeth, both the above genera approach American types; but in other characters, especially the form of the lower jaw, they appear to have been decidedly Mouse-like, and Mr. Alston regards them as most nearly related to the Dipodidæ, with which they are joined by a third form referred to the family *Issiodoromys*, a genus sometimes placed with the Jerboas. The teeth in this genus are of the same number as in the preceding, but the molars are much simpler, each of them exhibiting one large re-entering fold of enamel, which causes the surface of the tooth to present two heart-shaped lobes. This structure is not dissimilar to that prevailing in some Dipodidæ, and especially in *Pedetes*, but it was formerly thought to indicate a relationship to the Cavies, and accordingly the best-known species has received the name of *Issiodoromys pseudanæma* (*Anæma* being a sub-genus of Cavies).

This species occurs abundantly in the Miocene lacustrine limestone near Issoire. A second species (*I. minor*) has been detected in the Upper Eocene of Lamandine-haute.

Of the Octodontidæ, an essentially American family at the present day, nearly all the recorded fossil forms are also American. Species of *Echinomys*, *Loncheres*, and *Phyllomys* were obtained by Dr. Lund from the Brazilian bone-caves, which also furnished him with the remains of a Coypu (*Myopotamus antiquus*), and of an allied form, *Carterodon sulcidens*, distinguished by its having broad incisors with longitudinal furrows and raised ridges. The latter has since been found living in South America. Another species, allied to *Echinomys*, is named by Lund *Lonchophorus fossilis*. The superficial deposits of South America have yielded the remains of two species of *Ctenomys*, one of which is believed to be identical with a recent species. As several species of this family now live in Africa, the occurrence in the eastern hemisphere of fossil forms belonging to it would not be surprising, but the few that have been referred to it are of very doubtful nature. M. Lartet obtained some isolated teeth from the Miocene of Sansan, which he described under the name of *Myopotamus sansaniensis*; and one or two other types (*Aulacodon*, *Adelomys*), from Upper Eocene and Miocene beds, are of very uncertain position.

Of the Hystricidæ, or Porcupines, remains have been obtained in both hemispheres. In the Old World traces of true Porcupines (*Hystrix*) are recorded from the Valley of the Arno, from the Sivaliks, the Pliocene deposits of the Auvergne, from Pikermi, and, on very doubtful evidence, from the Upper Eocene of Lamandine-basse; whilst Dr. Leidy has described two teeth from the Pliocene deposits of Dakota, as belonging to a species (*Hystrix venustus*) allied to the European Porcupine. This determination, if confirmed, would be of great interest, as no true Porcupine now occurs in America. Of the American type, two species of *Sphingurus* have been obtained from the Brazilian bone-caves; and Professor Cope records a species of the North American genus *Erythizon* from a similar cave in Pennsylvania.

The Chinchillidæ have left but scanty traces of their former existence. *Lagostomus brasiliensis* is from the Brazilian bone-caves; and *Megamys patagoniensis* from the Eocene sandstone of Patagonia. The latter species is founded upon a tibia and rotula, which on comparison seemed to approach most nearly to those of the Rodents of this family, and if the determination be correct it was probably one of the largest species of the order, as the tibia measures about a foot long. *Amblyrhiza* and *Loxomylus*, are two genera described by Professor Cope from bone-caves in Anguilla Island, West Indies.

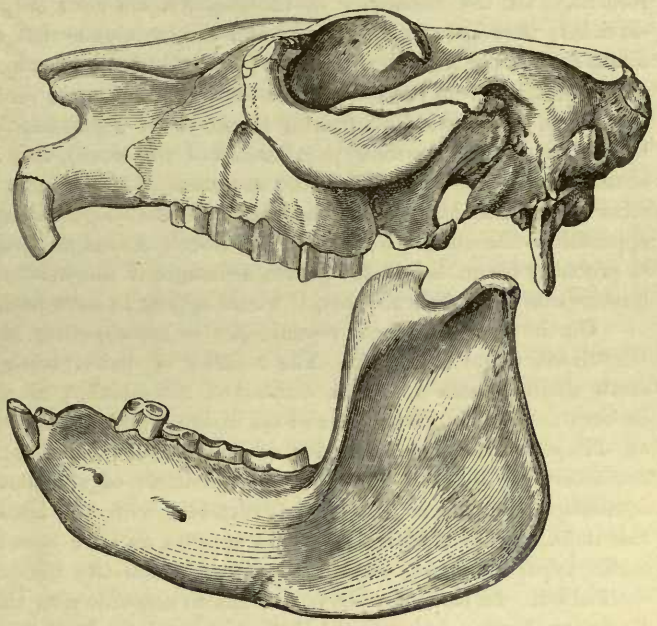
The Dasyproctidæ have but few fossil representatives, and the undoubted ones are all from the bone-caves of Brazil, which furnished Dr. Lund with two Agoutis and two Pacas. Of the former, one is described as *Dasyprocta capreolus*; the second is allied to the living *D. caudata*. The two species of *Cœlogenys* are extinct. Some teeth, found in Tertiary deposits of the Puy-de-Dôme, have been referred to *Dasyprocta*, but this determination is excessively doubtful. *Diobroticus schmerlingi* from Belgian caves has been placed with the Castoridæ.

Of the Caviidæ, Dr. Lund obtained three species of the genus *Cavia*, and two of *Hydrochœrus*, from Brazilian bone-caves. Of the latter, one was allied to the existing Capybara; the other was a gigantic species, measuring about five feet in length. Dr. Leidy has described a species (*Hydrochœrus æsopi*) from teeth found in Post-Pliocene deposits in South Carolina; and the Pampean deposits of the same age furnished M. D'Orbigny with the remains of a Cavy (*Cavia antiqua*) which, however, is doubtfully distinct from the Patagonian species.

The remains of species of the family Leporidæ are very abundant in some Post-Pliocene cave deposits on both sides of the Atlantic, and in several cases the species are evidently identical with those now living. Besides these, species of the genus *Lepus* have been found in Pliocene and Miocene beds in France. In North America three extinct Leporine genera have been recognised, differing from *Lepus* in certain peculiarities of the molar teeth:—*Palæolagus*, with three species, from the Miocene of Dakota and Colorado; *Panolax*, from the Pliocene marls of Santa Fé; and *Praotherium*, from a bone-cave in Pennsylvania. The last-named genus has the crowns of the molars transversely oval, and without the enamel-band or crest which is seen on the surface of the teeth of other Hares.

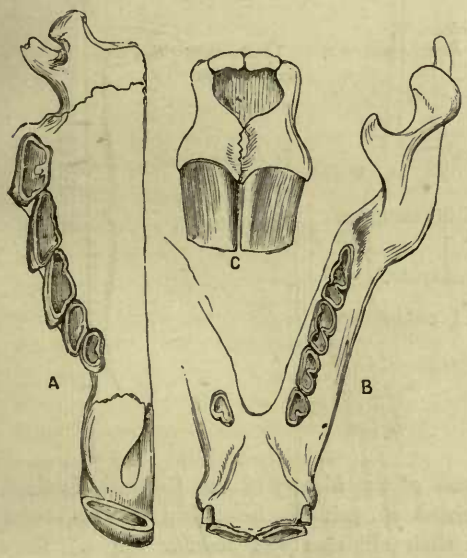
The Lagomyidæ are known in a fossil state chiefly from Post-Pliocene deposits, and the bone breccias of caves in various parts of Europe. In Post-Pliocene times the genus *Lagomys* seems to have been very generally distributed over the South of Europe; and the earliest appearance of the genus

is in the Pliocene, three species having been described from deposits of that age at Œningen and Montpellier. The family is, however, carried further back in time by the genus *Titanomys*, in which the molars differ but slightly in structure from those of *Lagomys*, but there are only four of them in each series, both above and below. Two species of this genus have been recorded from Miocene deposits in France and Germany.



SIDE VIEW OF SKULL AND LOWER JAW OF MESOTHERIUM CRISTATUM.

We have thus passed very briefly in review the fossil Rodents belonging to the two great sections of the order to which all its living species are to be referred; and it will be seen that while a knowledge of their existence is necessary to complete the history of the order, they present none of those peculiar characters which lend such interest to the fossil members of many other orders. There is, however, one fossil South American type to which we have yet to refer, as, by the curious combination of characters which it presents, it has long been somewhat of a puzzle to palæontologists, and although generally placed among the Rodents, its peculiarities are such that Mr. Alston found himself compelled to establish a third primary section of the order for its reception. According to M. Bravard, the first discoverer of this peculiar type, the Pliocene deposits of the Pampas of La Plata contain the remains of three species belonging to it; but the bones which have been sent to Europe, and which represent most parts of the skeleton, seem all to belong to a single species, which has been very fully described by M. Serres under the name of *Mesotherium cristatum*.* What distinguishes it at once from all other known Rodents is the presence *in the lower jaw* of four incisor teeth, the second pair being very small and placed immediately behind the outer edge of the broad middle pair. The latter are peculiarly widened and compressed from front to back in both jaws, and their summits, instead of being worn to a sharp chisel-like edge as in ordinary Rodents, show an elongated ring of enamel surrounding a slightly depressed surface. Hence Mr. Alston denominated this section HEBETIDENTATA, or BLUNT-TOOTHED RODENTS. The enamel in all the incisors is continuous round the tooth. The molar teeth are rootless and curved, the convex side being directed outwards, contrary to what occurs in other Rodents. They are surrounded by enamel, and show re-entering folds which differ in the two jaws. Their number on each side is five in the upper and four in the lower jaw. The skull is massive, with enormously-developed sagittal and occipital crests, the latter of which run forward so far as to join the zygomatic arches; and these crests rise so high that the upper surface of the actual brain-case is entirely concealed by them



DENTITION OF MESOTHERIUM CRISTATUM.
(A) Upper Jaw; (B) Lower Jaw; (C) Incisors.

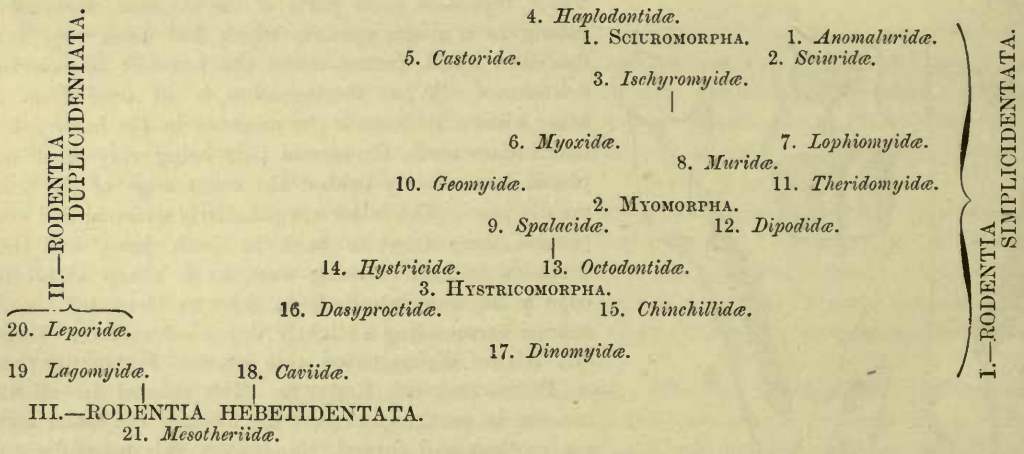
* Described almost at the same time by M. Bravard under the name of *Typotherium*. We here employ M. Serres' name.

when the skull is looked at from the side. The lower jaw in its characters presents some resemblance to the same part in the Leporidæ; but it has the condyle for its articulation with the skull transverse, and fitting into a cavity of corresponding direction, a character which occurs in no other Rodent. Of the remainder of the skeleton we need only state that the animal possessed perfect clavicles; that the shoulder-blade and humerus somewhat resemble those of the Beaver; that the fibula articulated with the heel-bone; and that both front and hind limbs possessed five toes, some of which, judging from the form of the terminal joint, were probably furnished with hoof-like claws.

Thus, as regards its affinities in the order Rodentia, *Mesotherium* presents resemblances in its lower jaw (as also in some peculiarities of the skull), and in the articulation of the heel with the shank, to the Hares; while in the shortness of the incisors and some other cranial peculiarities, the form of the shoulder-blades, and the probably hoof-like character of the claws, we may notice an approach to the Cavies, which are also South American forms, and especially to the Capybara, which it probably resembled in its habits, although, if the evidence of the Beaver-like shoulder-blade and humerus be taken into account, it would appear to have been still more aquatic.

On the other hand, the resemblance to certain other Mammalia, and especially to some aberrant Ungulates, is unmistakable. The number of incisor teeth is the same as in *Hyrax*, and in these teeth there is also a certain amount of resemblance to the curious genus *Toxodon*, in which the incisors are four in the upper and six in the lower jaw, and worn away in somewhat the same fashion. In *Toxodon* also, the convexity of the curve of the molars is turned outwards. Certain other characters of *Mesotherium*—such as the mode of articulation of the lower jaw, and the peculiar connection of some of the caudal vertebræ with the ischiatic bones—present resemblances to the Edentata. As Mr. Alston says, "It appears to have been a survivor, to Pliocene times, of a much earlier type, which represented an era at which the Rodents were not yet clearly marked off from their allies. In fact, *Mesotherium* seems to continue *into* the order Glires that line of affinity which Professor Flower has pointed out as extending from the typical Ungulates through *Hyracodon*, *Homalodontotherium*, *Nesodon*, and *Toxodon*."

The general relationships of *Mesotherium* to the other Rodents, and of these among themselves, are represented by Mr. Alston in a diagrammatic form, from which the following scheme, which will serve also as a table of the families, is derived:—

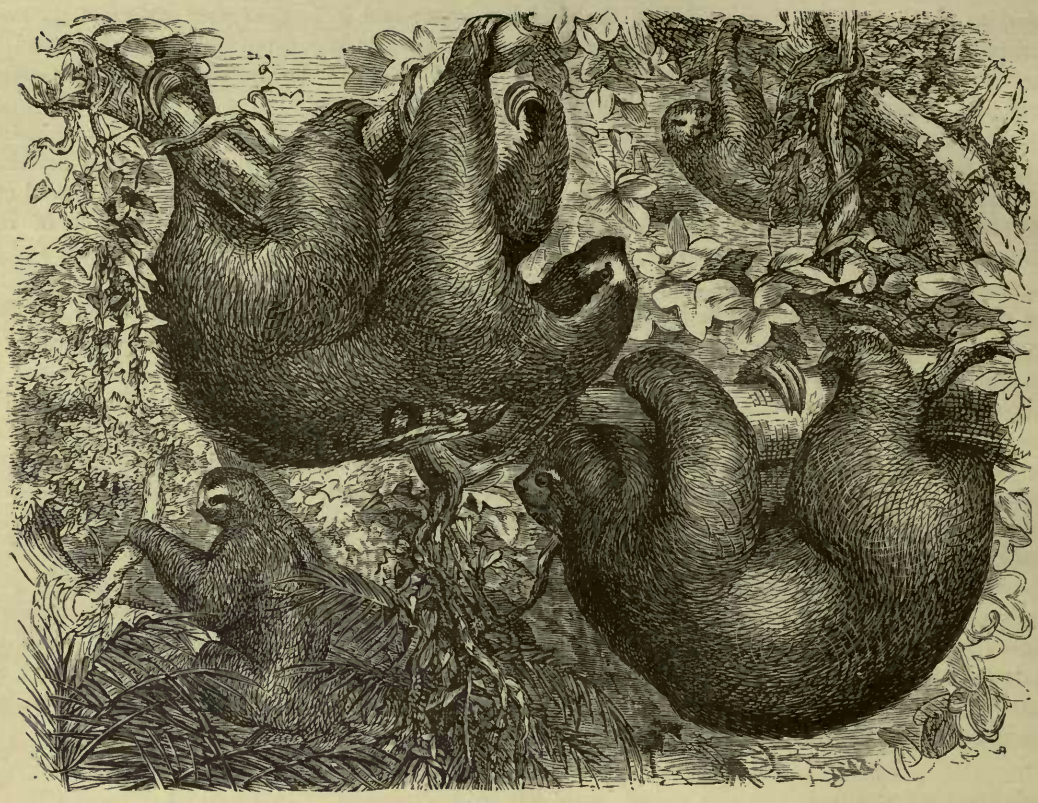


It seems quite clear, even from the above brief sketch of the history of the Rodentia in time, that, except in the case of *Mesotherium*, the fossil remains of animals belonging to this order furnish us with no important information bearing upon their alliances and possible origin. They make their earliest appearances, so far as we know, in deposits of Eocene age; and the earliest forms the remains of which are sufficient to give us a clear insight into their nature, are manifestly members of families, and often nearly allied to species still extant in the regions where their traces are now found. Thus in Eocene and Miocene deposits, we have representatives of the families *Sciuridæ*, *Castoridæ*, *Myoxidæ*, *Muridæ*, *Geomyidæ*, *Chinchillidæ*, and *Leporidæ*, already differen-

tiated as at the present day, so far as the evidence goes; and it is clear that we must go much further back in time to seek the earliest appearance of the Rodent type, whether it branched off directly from the Marsupial series, or passed, as would seem to be indicated by *Mesotherium*, through a sequence of forms more or less related to the Ungulates.

Nor does the geographical distribution of the animals lead to any more definite conclusions. Certain families and even sub-families are of very wide range, the Muridæ and Sciuridæ especially being represented nearly all over the world, while the Hystricidæ and Leporidæ are also spread over very large areas, occurring in both hemispheres. Certain groups, such as the Sciuridæ of both sub-families, the Castoridæ, the Murine, and Arvicoline sub-families of Muridæ, the Leporidæ, and the Lagomyidæ, may be said to have a circumpolar distribution in the northern hemisphere, nearly allied and sometimes identical species being found in the more northern parts of both the Old and the New World, but mixed with other forms peculiar to the regions, especially as we advance southwards. On the other hand, the Myoxidæ are peculiar to the eastern hemisphere, as are also the Spalacidæ and the Dipodidæ (with the exception of *Zapus*, which is considered by Dr. Coues to form a distinct family), and all the sub-families of Muridæ, except those above mentioned as having a circumpolar range. The Myomorpha may in fact be looked upon as an Old World group, the Geomyidæ being the only exclusively American family; while the Hystricomorpha as a whole may be regarded as American, certain aberrant forms of the Octodontidæ inhabiting various parts of Africa and the Old World Porcupines being the sole representatives of that great section outside the western continent. Considering these facts, we may regard the Sciuromorpha and the Duplicidentata as originally polar types, or at all events as having an equal claim to an origin in the northern regions of either continent; while the Myomorpha, with their multitudinous forms spreading over all parts of the Old World, and having a much scantier representation in America, probably originated in the eastern hemisphere, and spread by a northern passage into the New World; and the Hystricomorpha would seem to have originated in South America, where they display the greatest variety of forms.

W. S. Dallas.



GROUP OF SLOTHS (*Arctopithecus griseus*).

ORDER EDENTATA, OR BRUTA (ANIMALS WITHOUT FRONT TEETH).

CHAPTER I.

TARDIGRADA, OR SLOTHS.

The South American Forests—Discovery of the Sloth—How it derived its Name—Peculiarities of Dentition—Food—Fore Limbs and Fingers—Hind Limbs and Heel—Other Modifications of Structure—Kinds of Sloth—Waterton's Captive Sloth—Habits of the Animal—Burchell's Tame Sloths—Manner of Climbing Trees—Disposition—Activity among Trees—Naturalists' Debate about Anatomy—Probable Conclusion regarding it—Skeleton—Vertebræ—the Rudimentary Tail—Most Distinctive Skeletal Characters—Arm, Wrist, Hand, Fingers, Claws—Mode of Walking—Great Utility of the Claws—Face of Sloth—Skull—Teeth—Classification—*TARDIGRADA*—BRADIPODIDÆ—Genus BRADYPUS—Characteristics—Genus ARCTOPITHECUS—Characteristics—CHOLŒPODIDÆ—THE COLLARED SLOTH—Description—Skull Bones—Habits—Circulation of the Blood—*Rete Mirabile*—THE AI—THE UNAU—Appearance—Skull and Teeth—Skeleton—Interesting Anatomical Features—Stomach—HOFFMANN'S SLOTH—Description—Habits.

WHEN the dense forests of the northern parts of South America were first explored by Europeans, it was observed that active Spider Monkeys, Howlers, and their Quadrumanous allies, were not the only climbing animals which frequented the trees. For every now and then, hunters came in sight of creatures about the size of a large Monkey, but whose sluggish movements, long hair, short heads, small ears and tail, and very long claws, enabled them to be distinguished at once from their very lively companions. It was noticed that these new creatures, instead of climbing quickly and swinging from branch to branch and running along the boughs, moved very slowly, by hanging head and body downwards and grasping the branches with their long claws. During the daytime, these quiet animals were constantly found asleep, huddled up in the fork of a branch, and looking like great balls of tow, or else hanging by two legs, the rest of the body being curled up. Now and then, one was seen at the foot of a tree, and it appeared to run along the ground with great difficulty; for the arms were so long that it walked on the elbows, and the hind feet were turned in, so

that it supported itself on the sides of its great hind claws. Naturally, the animal took its time in moving, and as it was never seen to be lively, it received the name of Sloth. Interesting from being so different in its habits from other arboreal animals, it became much more so, to naturalists, when its remarkable construction was ascertained; but still the hairy creature with a short face, small head, long neck, hardly any tail, and very long front limbs, retained its popular name.

A very slight examination of one of the Sloths showed that it had no front teeth, that is to say, neither incisors nor true canine teeth, and that the hinder teeth—the false and true molars—were not like those of any other mammal. The back teeth, few in number, have since been ascertained to be exceptionally simple in their structure, and evidently the masticating process is very simple. But when it was noticed that the Sloth fed upon leaves and young twigs, the absence of the necessity for more elaborate teeth was acknowledged. Then it was observed that they had very long arms, or rather fore limbs, for the fore-arm bones and the humerus are all unusually long, and also that they had great power of movement. Moreover, it was seen that the fingers were reduced to three in number in some kinds, and to two in others, and that they were furnished with long and strong claws, which did not interfere with a great amount of mobility in the wrist. The length of limb, the mobility of the wrist, and the great claws, enable the Sloth to bring the leaves to its mouth, to hang on, and to walk, as it were, beneath the branches. An examination of the hind limbs showed that they were shorter than the others, and always furnished, in all kinds of Sloths, with three great claws. But the ankle seemed to be turned in, as if there was a state of "club-foot." This condition would enable the toes to clasp a bough without effort, but it would prevent the sole from being placed flat on the ground. As the knowledge of the anatomy of these constant tree-livers progressed, other modifications of structure, equally important in relation to the peculiar arboreal life and food, were gradually discovered. For instance, a remarkable flexibility of the neck, produced by the peculiar arrangement of the vertebræ; a *rete mirabile*, to a certain extent, in the limbs, resembling somewhat that in the Lemurs (Vol. I., pages 213, 245), and a complicated stomach suited for the digestion of leaves, and foreshadowing that of the Ruminants.

Two different kinds of Sloths were described in the first instance, and subsequently, several others. The first kinds known were the Ai, a Sloth with three claws on the fore limb, and the Two-toed Sloth, with two claws on the fore limb. The Ai was called *Bradypus tridactylus*, and the other the Unau, or *Bradypus didactylus*, names which have been changed somewhat, as will be seen further on.

Sloths are caught without much difficulty, and their habits, in captivity, have been observed in South America, and also after their removal to Europe. Waterton writes * on the subject:—

"Some years ago I kept a Sloth for several months. I often took him out of the house and placed him on the ground, in order to have an opportunity of observing his motions. If the ground were rough he would pull himself forward by means of his fore-legs, at a pretty good pace, and he invariably shaped his course towards the nearest tree; but if I put him upon a smooth and well-trodden part of the road, he appeared to be in trouble and distress. His favourite abode was the back of a chair, and often getting all his legs in a line upon the topmost part of it, he would hang there for hours together. The Sloth, in its wild state, spends its whole life upon trees, not upon the branches, but under them; he moves suspended from the branch, he rests suspended from it, and he sleeps suspended from it; hence his seemingly bungled conformation is at once accounted for. One day, crossing the Essequibo, I saw a large Two-toed Sloth on the ground upon the bank, and although the trees were not twenty yards from him, he could not make his way through the sand in time enough to make his escape before we landed. He threw himself on his back and defended himself with his fore-legs. I took a long stick and held it for him to hook on, and then conveyed him to a high and stately Mora. He ascended with wonderful rapidity, and in about a minute he was almost at the top of the tree. He now went off in a side direction, and caught hold of the branch of a neighbouring tree, and then proceeded towards the heart of the forest."

At Santos, in Brazil, in 1826, Mr. Burchell kept a tame Sloth, a *Bradypus tridactylus*, which at the end of two months pined and died. It fed exclusively on the buds and leaves of a species of *Cecropia*, a tree having a slender stem of thirty or forty feet long, with horizontal branches, hollow internally.

* Waterton's "Wanderings," pp. 161, 284.

and naked, except at the extremities. It ate only the young shoots and terminal buds of the unexpanded leaves, rejecting the old leaves on the boughs, which were brought to it daily. It was always perfectly silent, and its countenance and manners were most expressive of melancholy. It fed by day, and slept much; being kept in a room, it sat upright upon its short tail, embracing the legs of a chair with its arms and legs.

When resident at Para, near the mouth of the Amazons, Mr. Burchell also kept two full-grown Sloths, and a young one of a three-toed species (not *Bradypus tridactylus*, but of nearly similar form and habits), in a garden enclosed with strong stockades. They were kept tied up to the pillars of a verandah, to prevent their escape. Against these pillars they always placed themselves in an erect position, embracing the pillar with all four legs; when not tied to the verandah, they got up into trees in the garden. They slept both by day and night, always fixing their arms round something or other. Their food, consisting of branches, was brought to them in the verandah. They appeared extremely stupid, and would never come to the food. They would eat no leaves but those of the *Cecropia*.

They did not mount very large trees, and they ascended with their breasts pressing the trunk of the tree, advancing the hind-leg beyond the fore-leg. On the ground, they could neither stand nor walk, but lay sprawling on their belly, and dragged, or rather warped, themselves along, laying hold of a bunch of grass or stone with their three claws, which operated like grappling-irons, or, rather, pincers. All these died in a month or two. In their wild state they are seldom seen, from their colour mingling with the grey foliage of the trees, and from their being so extremely quiet and slow. The tame Sloths never willingly remained on the ground, except to pass from one tree to another. All the movements of the animal are slow. It moves its claws slowly. In eating it chews slowly; it also climbs slowly. The moisture of the leaves it eats suffices it for drink, without descending to obtain water. None of those kept by Mr. Burchell were ever seen to drink. The full-grown animals were never heard to utter any sound, but the young one occasionally, though rarely, gave a short cry or whistling squeak, of a single note.

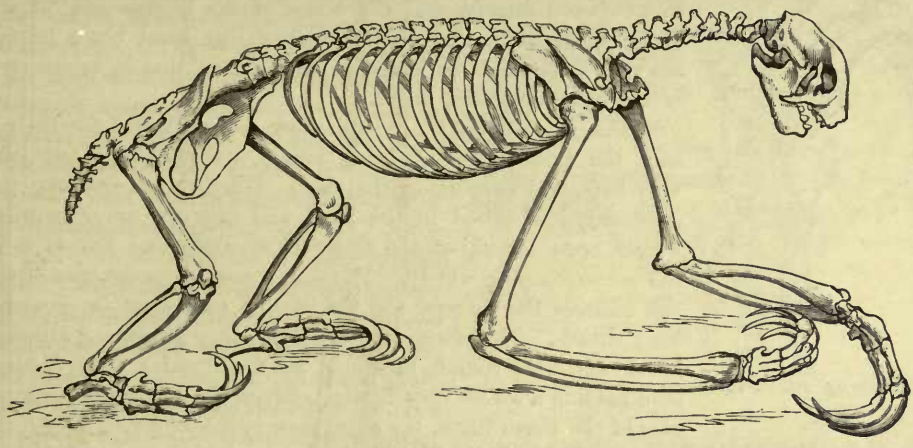
They showed no indication of fear, and seemed to give attention only with their eyes. They took no notice of the boy who often carried them across the garden to their place in the verandah, with their long arms sprawling; the only objects of their regard were trees. They fight on their backs, and grapple their enemy to strangulation. The use of the long wool that covers the body, and even the face, seems to be to guard them from the annoyance of insects. Possibly it may preserve them from the attacks of Snakes, which are, doubtless, their greatest enemies.

The Sloth spends nearly the whole of its life in the trees, and travels along the branches body downwards. It rarely comes to the ground, on which it walks with difficulty, and it occasionally takes to the water and swims. It looks slothful enough when asleep, for it then resembles a bunch of rough hair, and a jumble of limbs close together, hanging to a branch; but when awake, it is industrious in its search for nice twigs and leaves, and moves along the under side of the branches of the trees with some activity. It seizes the ends of adjoining branches, clinging to the leafy mass, and moves from tree to tree quickly enough, when it is requisite, and it has a very singular power of moving the head and neck backwards in seeking food. When the atmosphere is still, the Sloth keeps to its tree, feeding on the leaves and twigs, but when there is wind, and the branches of neighbouring trees come in contact, the opportunity is seized, and the animal moves along the forest, under the shady cover of the boughs. The Indians have a saying that "when the wind blows the Sloths begin to crawl," and the reason is thus evident enough—the animal cannot jump, but it can hang, swing, and crawl suspended. Mr. Waterton states, however, that "the Sloth travels at a good round pace, and were you to see him passing from tree to tree you would never think of calling him a Sloth. Being born up in a tree, living amongst the branches, feeding on leaves, and finally dying amidst the foliage, and enjoying life as much as any other animal, its structure and conformation are, of course, admirably suited for this arboreal existence. Its power of grasp is great, and is assisted by the great bent claws as it hangs by its feet when asleep, and also often when it is dead. One which was much frightened by being taken from the forest had a pole placed near it at a little distance from the ground, on two supports. It clung directly to the pole and hung on. A Dog was then made to attack the Sloth, which seized it in its long claws, and did not let go until the enemy died."

Leading thus a very unusual kind of life, up amongst the dense foliage, and having some very unusual peculiarities of construction, much debate occurred many years since regarding the general conformation as well as the special anatomy of the Sloths. One school of anatomists considered the Sloths incomplete and abnormal animals, moving with "pain" on the ground, and another regarded their unusual and peculiar anatomy as singularly beneficent.

But whilst it is perfectly evident that the long limbs and their joints, and the peculiar turning in of the ankles, and the structure of the clawed hands and feet, are all admirably adapted for the peculiar life which the animal leads, it appears to be consistent with anatomical reasoning to believe that the Sloth is an instance of retrograde development; that, in fact, the peculiar formation of the skull, neck, wrists, and ankles, is the result of the laws of disuse and adaptation operating on ancestral animals, which once had their anatomy more consistent with a perfect mammalian type.

When the Sloths were first carefully watched and studied, their length of neck and their ability to turn the head, so as to look at a person standing directly behind or beneath them, without swerving the body, struck Mr. Burchell especially. This curious peculiarity led to a careful examination of the skeleton of the different kinds, and much discussion followed, for it was found that in the Sloth



SKELETON OF THE SLOTH.

examined (the Three-clawed Ai) there were more neck bones (vertebræ of the cervical region) than in other Mammalia. Instead of the common number of seven neck bones, there were nine. This elongation of the neck of course permitted a greater amount of twisting than could occur in an animal with fewer neck bones. But there are other reasons why the head can be so much twisted round, for the spines on the neck bones are small, and the joint between the skull and the first vertebra is so fashioned that this remarkable motion is possible. There was a great deal of discussion about the extra neck bones, and as the last two had rib-like projections from their sides, some anatomists considered them to belong to the true rib-bearing vertebræ, or those of the back (the dorsal). But when the other Sloths were examined it was found that the number of the bones of the neck in all the two-fingered kinds was not as great as in other animals. There are only six neck vertebræ in one well-known species (*Cholœpus Hoffmanni*, for instance), whilst there are seven in another two-toed Sloth.

Eating largely and of bulky substances, the Sloths require a large digestive cavity, and the ribs are numerous, and the body is long and broad. There is much variation, however, in the number of the back bones in the dorsal and lumbar regions. Thus in the Ai there are sixteen dorsal and three lumbar vertebræ, whilst in the Two-fingered Sloth there may be twenty-three or twenty-four dorsal bones, and two, three, or four lumbar vertebræ. The ribs are close together and are broad. As the hind limbs require strong muscles, for the animal hangs on by them whilst it is feeding itself with the fore hands, the pelvis is large and is strengthened by having the hip and haunch bones (ilia and ischia) united to the conjoined sacral vertebræ, which may be six, seven, or eight in number. Moreover, all the strength of the pelvis is behind, the fore part or pubic bones being slender and united in front.

Some small tail bones exist, for that organ is rudimentary in all the Sloths, there being a stump in the Ai, and eleven very small bones; but in the Two-fingered Sloths the tail is not visible, and there are four little ossicles. There are no long and very prominent spines to any of the back bones, and the whole bony column of the spine is readily curved and bent. The animals so constantly bring the hands and feet close together, when hanging, that a ready bending of the spine is absolutely necessary. Moreover, in sleeping they often rest in the fork of a tree, or on a branch, and place the head between the hind legs, rolling the body up as it were in a ball, and this is facilitated by the peculiar construction of the long chain of back bones with small spines.

The most distinctive character of the skeleton of the Sloth is the excess of length of the fore limb over the hind one. An examination of the slender bones of the arm shows that they are more solid than those of most Mammals. The arm bone (humerus) has a hole through it in the inner expanded part, just above the elbow (inner condyle), in the Ai; but this is not found in the two-toed kinds. The wrist and hand are long and narrow, and this is produced by the union of some bones which are separate in other Mammalia, and the slight development of others. Thus there are six bones in the wrist instead of eight (the scaphoid and trapezium, and the os magnum and trapezoid have coalesced). In the Ai there are three clawed fingers, and the bones of the thumb and of the little finger are absent, and their corresponding hand bones (metacarpals) are very small, and are joined on to the next, that is, to the metacarpal of the index and third finger.

BONES OF HAND OF THREE-TOED SLOTH.

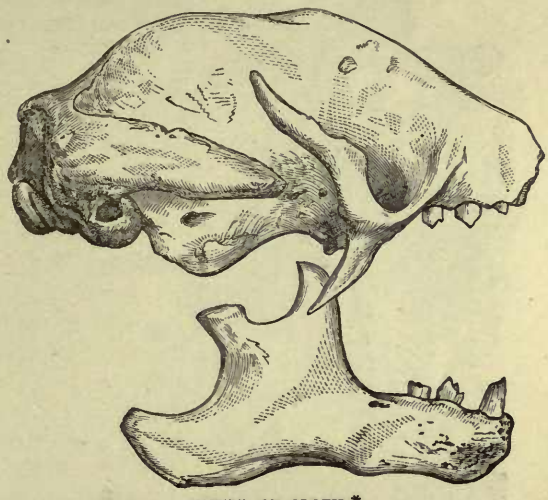
The three fingers are, moreover, strengthened for their peculiar uses, the first two joints being united, and the tip or last joint being very long, and supporting the claw. Moreover, as the long claws are constantly half closed in the hand, and they are never required to be widely open, the tip of the finger is so made that flexion is possible, but not unclasping widely. The skin comes up to the base of the claws, and encloses the fingers, and the base of each claw is protected by a bony sheath. They form capital hooks; they grasp, and although there is no opposable thumb, they hold the food; and a tame Sloth may be seen holding a carrot very firmly between them and the wrist. In the case of the Unau Sloth, the outer claw is the longer.

The Sloths walk on the outside of the extremities of the fore and hind limbs, and their claws are always curved in, and, as it were, retracted. Consequently, the animal cannot place the soles flat on the ground, and it cannot open its foot-claws to a great extent. This fixing of the claws assists in the clasping and hanging, which are the usual and commonest attitudes. The claws surpass the foot in length, and are so sharp and crooked that they readily seize upon the smallest inequalities in the bark of the trees and branches upon which the animals habitually reside. They and those of the fore limb are no mean weapons of offence and defence, for, situated at the end of long and muscular arms, they can drag, cling, and hold with great tenacity. The thigh bone (femur) of the Sloth is straight, and is thicker and shorter than the arm bone (humerus); it has no ligament to unite it to the joint (no ligamentum teres). On examining the lower bones of the leg (the tibia and fibula), they will be found to be bent, so as to leave a space between them, and they are shorter than the bones of the fore arm. The bones of the ankle joint, are united together immovably—that is to say, the usual bones seen in other Mammalia are there, but are united by bone. Moreover, this union includes the complete and ill-developed feet bones (metatarsals), and the first bones of the second, third, and fourth fingers. One bone is not included in this strange union. It is the astragalus, or the bone immediately jointed with the ends of the bones of the legs. The outer or small bone of the leg (fibula) fits into a pit in the outer part of the upper surface of this bone, and thus prevents any movement of the foot like a twisting outwards, and favours, but does not produce, the usual position of twisting inwards. Moreover, there are two powerful muscles in the front of the leg which are not opposed by others as strong, and they, by their contraction, keep the foot twisted inwards, as in club-foot (the anterior tibial and the long extensor of the great toe).

In the Unau, or Two-fingered Sloth, there is the same general arrangement of the bones and

muscles, with some important differences, which result in there being a greater amount of bending and extending of the foot, although the foot rests on its outer edge.

A Sloth's face is short, and there is a broad snub nose, with round nostrils, which are widely open. The cheeks become wide suddenly, and the forehead slopes rapidly backwards, the eyes being wide apart and small, but looking forwards. The head is small and round, and as it is covered with hair behind, it cannot be distinguished well from the upper part of the back of the neck. The expression of the face is always the same, and the method of masticating and eating is disagreeable to observe. The animal having no front teeth, and moving its jaws usually only upwards and downwards, and not from side to side, places the morsel, such as lettuce leaf or carrot, well into its mouth, and chews at it, dragging out the food every now and then, when it is covered with moisture. On examining the skull, the short cut off or truncated appearance of the face is very evident, and it will be observed that the teeth are wanting in the front bones of the face (the pre-maxillaries), and that only the palatal part of these bones exists. The lower jaw is strongly jointed to the upper, and the back part is large: there are teeth at the sides, but there are none in the front part of it. A very singular-looking cheek bone (zygoma) exists on either side. It is not attached behind to the ear bone, so as to cover the jaw muscles, but it has two processes behind —an upper and a lower—which differ in shape and size according to the species. The central bone of the nose does not reach to the nasal outlet, and there is a system of air-cavities which is continued from the nose into the forehead bone. In some kinds, the lower jaw ends abruptly in front, as in the Ai; but in the Unau Sloths it is slightly angular, and projects.



SKULL OF SLOTH.*
(From the *Proceedings of the Zoological Society.*)

The back teeth of the Sloths are very simple, and consist of three structures, called vaso-dentine, hard dentine, and cement, there being no proper enamel. The vaso-dentine is a kind of bony substance in the centre of the tooth, in which there are the passages and tubes of blood-vessels. The dentine is outside this, and consists of more earthy particles than the vaso-dentine, and of fewer tubes; it is all the denser and more resistant. Wearing away more slowly than the vaso-dentine, it forms a ridge which grinds easily. The cement is a kind of bony structure on the outside of the tooth. The teeth of the Sloth continue to grow from below as they are worn above, and there is no entire milk set which are replaced by those of a permanent kind.

The term Sloth is commonly applied to all the kinds of animals whose general shape and habits have just been noticed. It is evident, however, that this union of several species under one term is not correct in zoology, and it is necessary to distinguish them by peculiarities which are permanent. A very ready method of distinction is to separate the Sloths into two families, one containing those which have three claws on the fore limbs and the same number on the hind limbs, and the second including those which have only two claws on the fore feet and three on the hinder.

The first family is called the BRADYPODIDÆ, from βραδύς (slow), and πούς (foot), and the second CHOLŒPODIDÆ, from χωλός (halting, lame), and πούς (foot), and both are included in the group TARDIGRADA, or slow-moving *Edentata*.

The BRADYPODIDÆ include two genera, but many naturalists only acknowledge one. The first is *Bradypus*. This includes the Sloths with three-clawed fingers on the fore limbs, whose males and females are alike in their fur, and which have the cheek bone (malar bone) with two processes. The upper one is long and dilated at the end, and the lower is long and triangular, and neither of the processes reaches the ear bone. There are in these Sloths, when full grown, five molar teeth on each side in both jaws, and the first is very short. There are two mammæ on the chest.

* *Arctopithecus castaniceps.*

The second genus is *Arctopithecus* (Gray), and it contains species which have the males and females dissimilar in their colour and ornamentation, and the malar bone has a thin and narrow upper process.

The second family of the Sloths (the CHOLŒPODIDÆ) contains but one genus, *Cholœpus* (the Unau), whose species have two claws on the fore limbs and three on the hind ones. The front of the lower jaw is stuck out, and not cut short, and the first molar teeth are long.

The genus *Bradypus* probably contains several species, but it is only necessary to mention one, which is called

THE COLLARED SLOTH, OR THE HAIRY SLOTH.*

This Sloth lives in the densest forests of Brazil, Peru, and Para, and is found not far from Rio Janeiro.

It is a kind of the Three-clawed Sloths, in which there is little or no difference between the fur of the males and females. The neck is surrounded by a large collar of long black hair, and underneath this is a fur of a dark-brown colour. The face is naked, and is of a black colour, and the hair of the body is not very flattened, but is withered-looking to a certain extent. The forehead, temples, chin, throat, and breast are covered with reddish or rust-coloured hair, slightly grizzled. On the crown of the head it is long and yellow, and pale orange on the rest of the body. This Sloth produces one at a birth.

COLLARED SLOTH. (From Prince Maximilian of Neuwied's *Animals of Brazil.*)

The lower jaw has a kind of blunted lobe in front, and the angle of this jaw is broad, triangular, with a rounded lower edge, and it projects backwards beyond the joint which connects the bone with the skull. The cheek bone has those peculiarities which have already been mentioned. The teeth are peculiar, for the first or foremost grinders are smaller than the others, and the second upper grinder is the largest of all. The first grinder on the lower jaw is broader than the rest, and the hinder are the largest, being also cylindrical.

It has the general method of living of the Sloths, being perhaps not quite so lively or active as the Unau, and feeds mainly on *Cecropia* leaves, finishing those of one tree as far as it can before commencing those of another. Like all the Sloths, it has the power of long and sustained muscular action, and can cling on, or grasp, for a very long time without perceptible fatigue, and this gift is associated with a structure of the blood-vessels which supply the muscles, resembling, as we have said, that noticed in some of the Lemurs. The main artery which supplies each of the fore limbs is the axillary, so called from its being found in the armpit or

* *Bradypus torquatus*, or *Bradypus crinitus*.

axilla. In quickly-moving animals this vessel reaches into the upper arm, and divides into a few rather large ones lower down, and these give off others, so that a certain quantity of blood is supplied and removed quickly. But in the Sloths the axillary artery divides at once into a number of cylindrical vessels nearly as large as it is, and they are united here and there. These unusual arteries are found in contact with the surface of the muscles, and their branches go in and amongst the muscular bundles. As many as forty-two of these large vessels were counted by Sir A. Carlisle, on the surface of the muscles on the front of the arm, and probably about twenty were inside. These arteries thus carry an immense supply of blood to the muscles, but blood which, although it is finally removed by the veins, does not move very rapidly. In fact, the muscles are turgid with blood. The same arterial structure is seen in the hinder limbs, and the arteries of the thigh form as numerous a set as those of the arm.

AI. (From the *Proceedings of the Zoological Society.*)

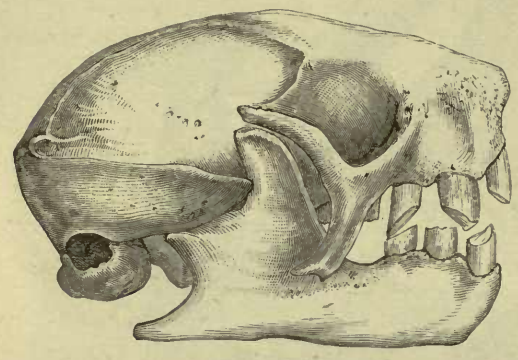
It seems to be in accordance with careful investigation, to state that the species of Sloth called *Bradypus tridactylus* (the Three-toed Sloth, or Ai) has too large a meaning, and that it really refers to the Collared Sloth, as well as to others which have been placed in the next genus. It is as well to remark here, that although there are three clawed fingers to the fore limb, there are vestiges of two other ones by their side in the form of two rudimentary metacarpal bones.

GENUS ARCTOPITHECUS.—THE AI.*

Several kinds of three-clawed Sloths have been called Ai; for instance, the Yellow-throated Ai, and De Blainville's Ai, and all have been named *Bradypus tridactylus*. Dr. Gray, however, satisfied himself that the kind which was first described by Cuvier as the Ai, and which is figured in Prince Maximilian of Neuwied's "Animals of Brazil," is the same as one which has since been called *Arctopithecus Ai*, or *Arctopithecus flaccidus*. The word *Ai* is taken from the noise made by the animal, and the term *flaccidus* relates to its long hair. The true Ai inhabits Venezuela and Peru, and has very long flaccid grey hair mottled with white. There is an abundant under-fur of a blackish-brown colour, which has white and black in spots and blotches.

* *Arctopithecus flaccidus.—Arctopithecus Ai.*

There is a small spot between the shoulders on the back, where the fur is soft and woolly, and a broad, short, blackish streak there, with a white or orange ring around it. The claws are coloured brown. The head has a curiously-cut short and turned-up nose appearance, and is furnished with coarse shaggy hair, disposed on the crown in a diverging manner. The short hair of the face contrasts with the long, shaggy, shrivelled, dry, hay-looking hair of the body. This hair is coarse and flattened at the ends, but it is exceptionally fine at the roots, and it greatly resembles in colour and texture some of the vegetation of the trees on which it lives. The eyes are bright, and are surrounded by a dark ring. Several species of the genus Arctopithecus have been described which live in Guiana, Bolivia, Brazil, Peru, and Venezuela.



SKULL OF AI.

The next genus of the Sloths is represented by

THE TWO-FINGERED SLOTH (THE UNAU).*

There are several kinds of Sloths with two "toes," or rather with two fingers ending in claws on the fore limb, but the differences between the species are not very readily appreciated. They are differences which can be recognised, but it is doubtful whether the possession of dark brown or pale brown hair is sufficient to decide that there are more than one species.

The common Unau Sloth is usually of a darker tint than the others, but there is no doubt that the specimens in museums of all these Sloths vary much in the colour and length of the hair. Thus the hair may be generally dark, and the hairs of the crest on the back of the head may be white, and more or less tinted with bright green; or the hair may be short, of a dark brown colour, paler on the rump, much paler on the head, cheeks, and chin; a band may be across the nose, and the orbits dark brown. Others of the same species have very long hair, of an uniform dark tint, paler on the head and redder beneath, whilst one from Juan de Fuca has short hair, without any indication of a crest. From Brazil there are specimens with long paler hair and a crest. All these specimens, however, have pale whitish claws.

A Unau from Columbia is of a pale and whitey-brown paper colour, darker at the root of the hairs, and it has pale fawn-coloured claws.

In all these animals with different kinds of furs, the two-clawed condition is peculiar to the fore limbs only, for on the hinder there are three claws, and it is to be remarked that the hair and skin unite the fingers and toes close up to the base of the claws. The skull of the Unau is rather projecting in front, and not, as it were, quite cut off close; and there is a great gap in the upper and lower gums in front, the incisor teeth being absent, of course. But at the side of the mouth there is a longish tooth above and below, looking like a canine, but really it is the front molar, which in both jaws and on both sides is longer and larger than the others. The under teeth belonging to the lower molar set are placed behind the corresponding upper ones when the mouth is shut.

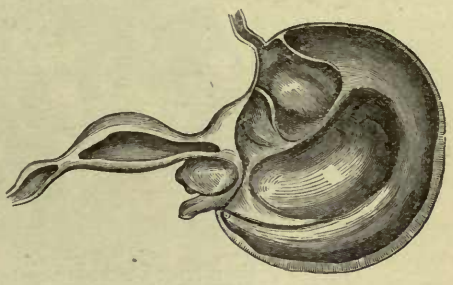
The cheek or malar bone is seen, on looking at the skull, to be separated from the ear bone, and to have a forked end posteriorly, the lower part of the fork extending downwards and backwards.

The lower jaw is very straight: it projects a little, in front and behind, where it is jointed with the upper jaw, there is no upright portion or branch, or ascending ramus. The last back tooth is just in front of a curved piece of bone called the coronoid process, the base of which is on a level with the line of the teeth.

This Sloth has seven neck bones (cervical vertebræ), and the last one has a very small and rudimentary rib attached to it on either side. There are no less than twenty-three dorsal vertebræ found to be with ribs. The Unau has a clavicle which is much smaller in the other group. It has no tail. The structure of the ankle joint enables it to turn in, even more than that of the Three-clawed Sloth. As the habits of the Unau Sloth are the same as those with three claws, and all live in the same

* *Cholœpus didactylus.*

great district, these anatomical distinctions are very interesting, and relate to their remote ancestors, being hereditary legacies, which are of little or no importance in assisting the creature merely to live. One of the differences between the Sloths is singular. The Unaus have a very remarkably formed stomach, which may be said to be double. The first stomach is large and rounded, but it is contracted behind, and then formed into a kind of conical appendix. This appendix is doubled from left to right, and its cavity has a fold at its opening into the stomach. It forms a special part of the first stomach. Then it is to be noticed, that where the food enters the stomach, or at the opening, which is called the cardia, there is a pouch, looking like a bag at the end of the tube which runs down from the gullet to the stomach. This is the second part of the first stomach : and the third is a tube-like space which connects the cardia with the stomach far away to the left. These three cavities form the first stomach. The second stomach is of a slender form, and is very much smaller than the other. Its walls are thin for the first half of its length, but towards the spot where the gut commences (the pylorus) they are thick and muscular. A small fold occurs midway. There is a fold in the body of the smaller or second stomach, and there is a little hollow there with glands in it, and it is called the appendix to the second stomach.



STOMACH OF SLOTH.

The stomach is thus rather complicated, and its internal mucous membrane is so thrown into folds, and made into hollow spaces, that it occupies much more space than if it were a simple bag. This plan is also well seen in those ruminating animals which, like the Ox, live entirely upon vegetable substances; and it is evident that the diet of the Sloth bears some relation to the complicated stomach.

In the Ai, the appendix to the second stomach is larger than that of the Unau Sloth, and is more complicated.

HOFFMANN'S SLOTH.*

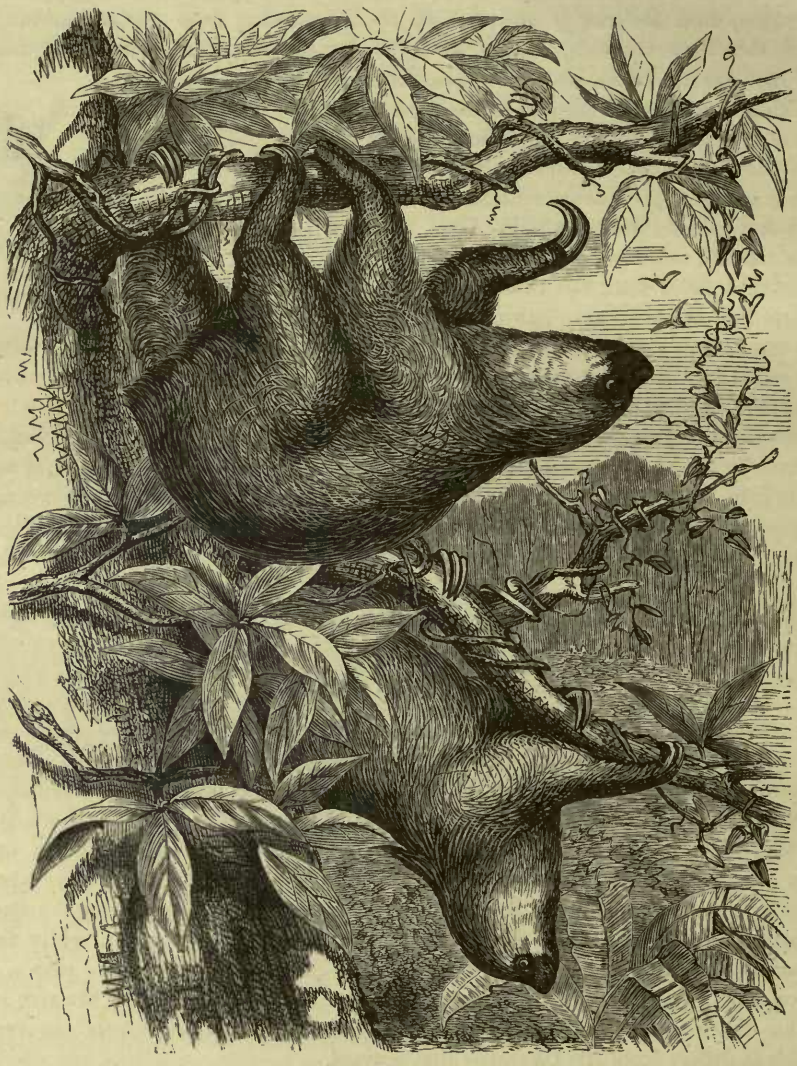
This is a Sloth with two clawed fingers on the fore, and with three claws on the hinder extremities. Living specimens are occasionally brought to Europe, especially from Porto Rico, so that its general appearance may now and then be studied at the Zoological Gardens, in the Regent's Park. If it be looked at there in the day-time, it certainly merits the name of Sloth, for it resembles a bundle of long, light, brown hair, fixed on the top of a bar of wood close to an upright branch, or huddled up in a corner on the ground; but in the morning, and also late in the evening, the creature begins to move slowly, and to look out for the food put for its use on the floor of the den. All the Hoffmann's Sloths have pale brown hair, whiter at the tips, and a white face, showing a brown band across the nose, extending to a ring round each eye. They have also a long and full crest of hair on the neck, and the hair on the limbs is darker than that of the rest of the animal. Dr. Peters, who discovered this Sloth, examined the skeleton, and found only six vertebræ in the neck, and in this it differs from the *Cholœpus* just noticed.

When its food, consisting of carrots and lettuce, and bread-and-milk, is put down in the morning it is soon in movement, and enjoys its meal hanging down from a bar with its hind legs, and resting its back on the floor of the cage. It seizes the food between the claws and the long straight palm of the fore-foot, and passes it into its mouth, chewing actively with the molar teeth, especially with the first, which are sharp. It cares little for the spectators, and when it has finished, slowly mounts up into a corner of its little den and settles down to sleep. In the evening it becomes lively, for it is, and, indeed, all Sloths are, nocturnal in habit. The hairless snout, of a light red tint, the absence of "smellers," the little eyes with a few hairs around them, and the broad forehead, give the animal a curious appearance. The hair is brushed back on the forehead, and comes around the very small ears on to the cheeks, and is whitey-brown, and this same tint is seen over the whole of the back in long slender hairs. But the under hair is light red or red-brown. The long and

* *Cholœpus Hoffmanni.*

slender hand, with its two claws, contrasts with the rather bulky upper part of the limbs, and the flesh-coloured palms are very remarkable.

The whole of the Sloths lead very monotonous lives; their food is ever within their reach, and it is abundant, and they do not appear to have to compete much or at all in the struggle for existence



HOFFMANN'S SLOTH.

with other animals. Their enemies are Snakes and the Carnivora, but it is evident that they are much more readily preserved by their habits from the latter than from the former. Leading such an uneventful existence, there is no great call upon their nervous energies or intelligence, and these are at a low pitch. The brain consequently is very simple in regard to convolutions, which are few in number and shallow.

CHAPTER II.

THE ANT-EATERS.

THE CAPE ANT-EATER—The Cage at "the Zoo."—Appearance of the Animal—Its Prey—The Ant-hills—How the Orycteropus obtains its Food—Place in the Order—Teeth—Skull—Tongue—Interesting Questions concerning the Ant-eater—THE PANGOLINS, OR SCALY ANT-EATERS—THE AFRICAN SCALY ANT-EATERS—Differences between the Pangolins and Cape Ant-eaters—Their Habitat—Description—TEMMINCK'S PANGOLIN—Habits—Food—How it Feeds—Superstitious Regard for it shown by the Natives—Scarcity—Appearance—THE LONG-TAILED, OR FOUR-FINGERED PANGOLIN—THE GREAT MANIS—THE ASIATIC SCALY ANT-EATERS—THE SHORT-TAILED, OR FIVE-FINGERED PANGOLIN—The Species of *Manis*—Skull—Stomach—Claws fitted for Digging—Other Skeletal Peculiarities—THE AMERICAN ANT-EATERS—General Appearance—Genera—THE GREAT ANT-BEAR—Habits—Diet—How it Procures its Food—Distribution—Mode and Rate of Locomotion—Stupidity—Manner of Assault and Defence—Stories of its Contests with other Animals—Appearance—THE TAMANDUA—Description—Where Found—Habits—Odour—THE TWO-TOED ANT-EATER—Appearance—Two-clawed Hand—Habits—Von Sach's Account of his Specimen.

THE CAPE ANT-EATER *—THE AARD-VARK.

IN one of the cages in the house, close to where the Kangaroos are kept, in the Zoological Gardens of London, there is usually a heap of straw to be seen and an empty dish. Outside the cage is placed the name of an animal, "The Cape Ant-eater." People look and wait, and as neither the animal nor the Ants it eats are to be seen, they go away, supposing that the absence of the last-named insects has caused the destruction of the animal, whose straw alone remains.

But in the evening, and sometimes in the morning, when the food is placed in the cage—not Ants, however—a long pair of stuck-up ears, looking like those of a gigantic Hare with a white skin and little fur, may be seen poked up above the straw; and, soon after, a long white muzzle, with small sharp eyes between it and the long ears, comes into view.

Then a very fat and rather short-bodied animal with a long head and short neck, low fore and large hind quarters, with a bowed back, comes forth, and finally a moderately long fleshy tail is seen. It is very pig-like in the look of its skin, which is light-coloured and has a few hairs on it. Moreover, the snout is somewhat like that of a Pig, but the mouth has a small opening only, and to make the difference between the animals decided, out comes a worm-shaped long tongue covered with mucus. The animal has to content itself with other fare than Ants in England, but it seems to thrive, and as it walks slowly on the flat of its feet and hands to its food, they are seen to be armed with very powerful claws.

In Southern Africa, whence this animal came, it is as rarely seen by ordinary observers as in England, for there it burrows into the earth with its claws, and makes an underground place to live in, and is nocturnal in its habits, sleeping by day.

The Orycteropus, which means digging-up foot, from ὀρύσσω (to dig up), and πούς (foot), is the deadly foe of the Ants of all kinds, and especially of those which, like the White Ants, live in large colonies and build nests.

These nest-building Ants abound in certain districts, but not in the region of the downs or karoos, nor where it is very dry and woody. They choose the country which is covered with a poor and so-called "sour" grass, and there they dig galleries in the ground, fetch earth from far and wide, and erect large rounded mounds of an elliptical figure, and often from three to seven feet in height. Apparently fond of company, the Ants congregate, and these gigantic hills of theirs are often crowded together and occupy the plains, as far as the eye can reach. The nests, or hills, are solidly built, and contain innumerable ants. This is the favourite resort of the Orycteropus, and the insects are his sole food then. Wherever ant-hills are found, there is a good chance of finding one of these Aard-varks, or Innagus, or Ant-Bears, as the Dutch and natives call them, leading a sort of mole-like life. But he is not easy to catch if the stories told be true. It is stated that the long strong flattened claws and short extremities, worked by their strong muscles, enable the animal to burrow in the soft soil as quickly as the hunters can dig, and that in a few minutes it will get out of the way; moreover, its strength is sufficient to resist the efforts of two or three men to drag it out of the hole. But when fairly caught, the Ant-eater does not resist much; it has no front teeth or eye teeth to do any harm with, and

* *Orycteropus capensis* (Geoffroy).

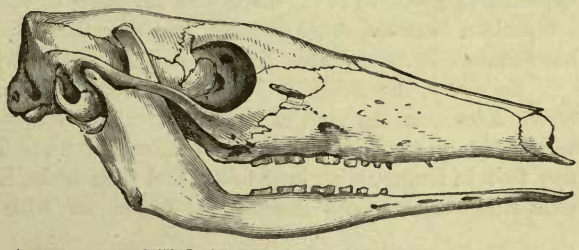
it can be killed easily by a blow on the head. The Ant-eater runs slowly, and never moves far from the entrance of its burrow, being seen to do so only at night-time. The burrows are often two feet in diameter and three or four feet deep before they branch off. Night is the time for Ant-eating, for the active and industrious insects are then all at home and within their solid nests. Then the Orycteropus sallies forth, finds a fresh nest, sprawls over it, and scratches a hole in its side, using his strong claws, and then introduces his long snout. Having satisfied himself that there is no danger at hand, the animal protrudes its long slimy tongue into the galleries and body of the nest, and it is at once covered with enraged Ants, which stick to it, and are finally returned with it into the mouth. This goes on over and over again, until the appetite is satisfied; and apparently the diet is excellent, for the Ant-eater is

CAPE ANT-EATER.

generally fat, and indeed his hams are appreciated as a delicacy for their peculiar flavour, into which that of formic acid is said to enter.

Although without an armour to its body, and provided with only a thick skin and bristles, the Orycteropus has a great resemblance in many points of its anatomy to the Armadillos of America. It is more closely allied to them than to the other Edentata. It is one of the order of Edentata, for there are no front teeth in the jaws, the incisors and canines being absent. The teeth are found in the back part of the mouth, and there are five on each side and in the upper and lower jaws, or twenty in all; there are also some small teeth which fall out during the growth of the animal. As might be expected from the very simple nature of the diet, the teeth are not at all complicated in their structure. They increase in size from before backwards, the last tooth but one being the largest, and all are peculiar in their minute construction. The first permanent tooth, which may be called a molar, is cylindrical in shape, and consists of a centre of very remarkable substance, for the body of the tooth is composed of a great number of vertical canals placed side by side, and running up the tooth. It was this interesting structure, so different to that of other animals, which led Cuvier to compare the teeth to pieces of cane. Outside this part of the tooth is a hard and more solid substance. When

the teeth are unworn, this outer covering covers their top, but as it wears off the tubular appearance is seen, and the ends of the tubes become exposed. The teeth have no fangs like those of such orders of Mammalia as the Carnivora and Insectivora, and they increase in length by growth from below, so that the wear above is continually compensated for. The second tooth resembles the first in its minute construction, but appears like two cylinders fixed together, a longitudinal groove indicating the junction, and this is the appearance presented by most of the others. The hindermost teeth resemble the first molars. The dental number varies according to age, and the presence or absence of the teeth which are not permanent. The jaws, in which the teeth are fixed, are long, and the lower one is low, but there is an ascending back part, or ramus; consequently, the face is long and low. The eye is placed far from the ear, and is small. Its bony case, or orbit, and its surrounding bones, are somewhat remarkable for an Edentate, for there is a lachrymal bone, and the tear canal is open on the bony face. Moreover, the malar bone is united to the ear bone by a complete arch, the zygoma, and the deficiency so remarkable in some other Edentates is thus not observed. The pre-maxillary bones are also to be seen, in front of the face. In this completeness of the bones of the face this animal is a true mammal, but in the nature and extent of the ear bones, the Orycteropus has some resemblance to reptiles and birds.



SKULL OF THE CAPE ANT-EATER.

The tongue is long, narrow, and flat, and can be protruded considerably beyond the mouth, but not so far as those of the other insect-eating Edentata; and in order to keep up a supply of thick mucus, the glands under and at its side, or the sub-maxillary, are very large and active in their functions. The stomach is moderately bulky and not simple, for the portion towards the right has very thick muscular walls, and the rest is thin. The intestine has a blind gut, or cæcum.* In fact, the stomach and blind gut might belong to an animal which eats something more bulky and less nutritious than Ants, and would be of use to the creature, did it eat vegetable matters. All these structures, the simple teeth, the tear bones, the size of the ear bones, the Sloth-like teeth, with tubes, however, and the peculiarities about the intestinal canal are, it must be remembered, associated with the life of a purely insectivorous animal. Why has it not the kind of teeth of the Insectivora and their stomach? and why should it combine high and low characters in its skull? These are questions which, when attempted to be answered, show that in the great philosophy of nature causes and effects are not everything, and that the same definite methods of life may be followed by animals very differently constituted.

The claws of the Orycteropus and the limbs are admirably suited for its kind of life. There are five claws on the hind limbs and four on the front, and they are long, slightly curved, flat, and scooped out below. The burrowing is facilitated by the arrangement of the claws as regards length, and they diminish in size from within outwards. There is a collar bone. The foot rests evenly on the ground and not on its outside, and the body is supported either by the whole foot or by the palm surface of the claws. The fore arm can be rotated more or less, and the pronator quadratus † muscle enables this necessary action to be carried out. The *Orycteropus capensis* lives over a wide extent of country in South Africa, in Caffraria, and in the western districts. A closely-allied species lives in Senegal (*Orycteropus senegalensis*, Less.); and a third is found in Southern Nubia, near the White Nile (*Orycteropus æthiopicus*, Sund.).

* The uterus is double, and the placenta is disc-shaped, and is cast off (deciduate). There are chest and inguina teats. The vertebræ are—seven cervical, thirteen dorsal, eight lumbar, six sacral, twenty-five caudal.

† The muscle called pronator quadratus is a fleshy band, four-sided in shape more or less. One side is attached to one of the bones of the fore-arm, the ulna in front above the wrist; and the other and opposite side adheres to the radius. The ulna being motionless, the muscle contracts and pulls the radius over, so as to turn the back of the wrist forwards, or upwards. The prone position is thus produced, and hence the name of the muscle. The other muscle which produces this movement is fixed to the fore-arm in front, near the inner elbow, and it is long, having a tendon which is implanted on the radius. As this muscle contracts, it pulls the radius over the ulna, and makes the wrist take up a prone position. It is called the pronator teres.

THE PANGOLINS, OR SCALY ANT-EATERS.*

THE AFRICAN SCALY ANT-EATERS.

An animal living in the same country, on the same kind of food, and having many of the habits of the Cape Ant-eater, especially as it belongs to the same order of the animal kingdom, might be expected to resemble it in shape and in most of the important parts of its construction. But the comparison between the Ant-eater, just described, and the Scaly Ant-eater, shows that these animals have some very remarkable differences. The Scaly Ant-eater is toothless, and covered with scales.

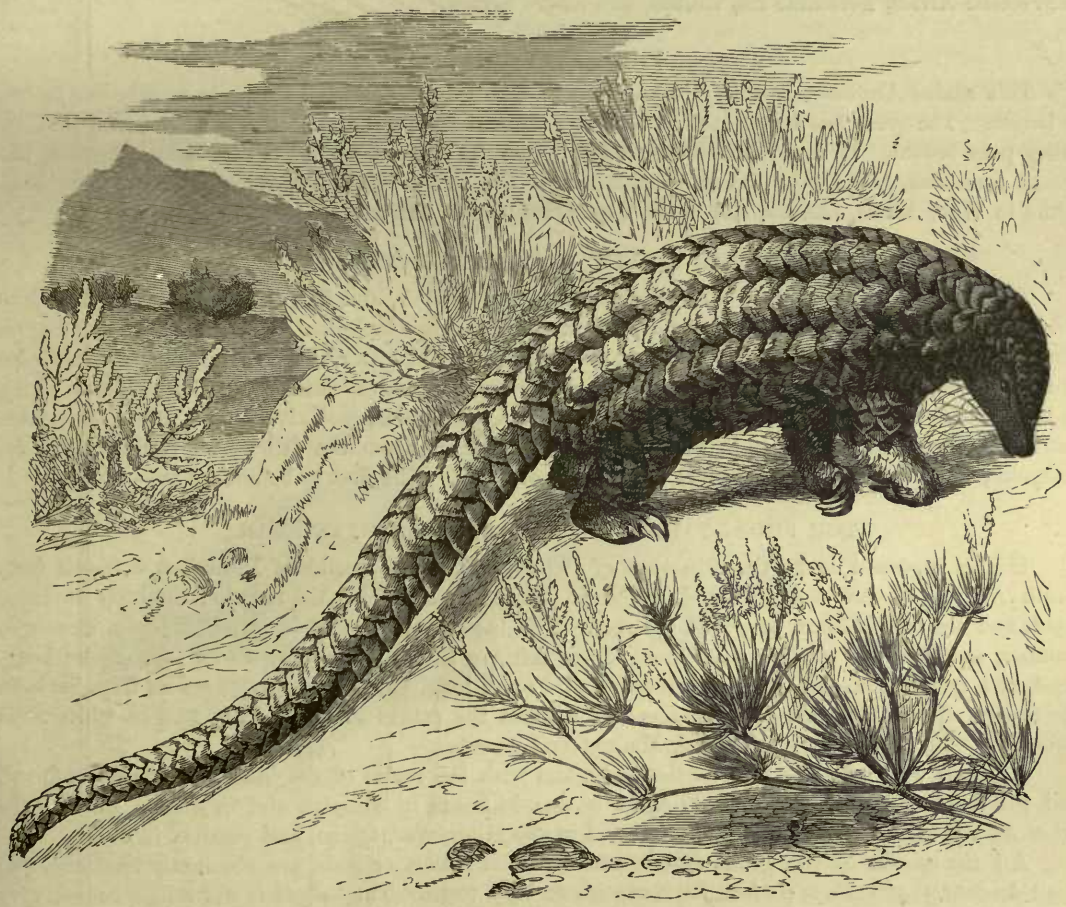
Formerly, the Scaly Ant-eaters roamed far south in Africa, but now they are rare animals in South Africa, in the west of the continent, and across to Sennaar. They are found in Zanzibar, and as far south as the latitude of Mozambique. They are small animals, of from two to nearly five feet in length, with long tails; and their body, limbs, and tail are covered with numerous large, somewhat angular, and sharp-edged scales, as with armour. The scales overlap each other like

TEMMINCK'S PANGOLIN.

tiles, and the free part pointing backwards is bluntly angular or rounded at the tip. When the animal is on its feet walking, they form a very close and impenetrable covering, being doubtless of great use to the creature, for it must trust entirely to its defences, having no weapon of offence. But when the Scaly Ant-eater is alarmed or threatened with danger, or positively attacked, it rolls itself up like a ball, places the snout between the legs, and the tail underneath, and then sticks up its scales, offering their sharp edges to the enemy. There are several kinds of them, and one in particular was noticed by Dr. Smith, the African traveller, and was named after the zoologist Temminck, MANIS TEMMINCKII. He observed that it was rarely seen, but that when it was discovered, instead of burrowing, it did not attempt to escape, but rolled itself up instantly in the shape of a ball, taking especial care of its head, which is the only part unarmoured and likely to be injured. He states that Ants form its chief and favourite food, and that it secures them by extending its projectable tongue into holes which may exist in the habitations of those insects, or which it may itself form. The tongue having made an entry, it is soon covered with a multitude of insects, and as it is well lubricated with saliva, they are held fast, and when a full load is ready, the retracting muscles act on the tongue and the whole is carried back into the mouth, after which the Ants are swallowed. The same traveller accounts for the scarcity of the Scaly Ant-eaters, partly from the disinclination of the natives to discover them for strangers, and partly because they are environed with supernatural

* Genus *Manis*.

gifts in their eyes. They are carefully sought for, by the natives, for their own use and supposed advantage, for they believe the animal to have some influence on cattle, and that certain treatment to which they are exposed produces this. Whenever a specimen is secured by the natives, it is submitted to fire in some cattle-pen, apparently as a burnt offering for the increase of the health and fertility of all cattle which may henceforward enter the fold. "Here," writes Dr. Smith, "we have another cause for the obliteration of a species. Intolerance of their aggression has wrought up the shepherd or agriculturist to the destruction of some; but in this case, a species is probably dying out under the influence of a superstition."



FOUR-FINGERED PANGOLIN.

They burrow even in rather hard ground, and feed at night time. It has been noticed that the mother sits upright when enticing the young to suckle.

This *Manis* has rather a short head, and a wide body, and the tail is as long as the trunk : it is rather less in width near the body, and does not diminish much near the end. In a specimen which is twenty-five inches and a half long, the back of the animal is eight inches across, and the tail at its root is five inches broad. The scales are large, and are in about eleven rows. The body is of a pale yellowish-brown colour, the scales being lightest in tint near their points, and they are often streaked with yellow. Where the scales are wanting the skin is dusky brown. The eyes are reddish-brown, and the muzzle is black. The nails of the fore feet are bent under, so that the animal walks on their upper part. The scales are composed of hairs placed side by side and agglutinated together, and when first formed, and for some little time after, they are soft. They cover the upper part of the fore and hind extremities besides the body, and are striated. This kind lives in Eastern Africa, Sennaar, Caffraria, Kordofan, and Latakoo.

THE LONG-TAILED, OR FOUR-FINGERED PANGOLIN.*

This Ant-eater is from two to three feet in length, and the tail is twice as long as the body. It inhabits the Guinea Coast and the Gaboon, and probably Senegal. It is a dark brown animal, with the hair of the face and under sides black in tint. There are eleven series of scales, with the end rounded, and a central prominence.

Buffon described a pale brown or horn-coloured, very scaly, long-tailed Ant-eater as a Phatagin, but it is correctly called *Manis tricuspis*, from the scales having three projections on them. It lives in Western Africa, Fernando Po, Guinea, and Sierra Leone.

THE GREAT MANIS.†

This scaled Ant-eater is thirty inches long in the body, and its tail measures twenty-five inches in length. The great tail lessens to the end, and the scales are striated at the base, the whole colour being pale brown. It is an interesting animal from its likeness to one of the Asiatic species, the *Manis pentadactyla* (Linn.); but the difference in the length of tail is remarkable. It has been found in West Africa, Guinea, and in the Cape Coast Castle district.

THE ASIATIC SCALY ANT-EATERS.

There is one point of great interest about the genus *Manis*, and it is that it is not restricted to Africa, for some species are found over a wide extent of country in India. They live there in a region from the Himalayan Mountains to Ceylon, and eastward to Sumatra and Java, and in Southern China as far as Amoy, Hainan, and Formosa. They afford an instance of closely-allied animals now living in large districts which are separated by seas, deserts, mountains, and rivers, and other impassable barriers. The Javanese are said to have called the animal, from the fact of its rolling itself up, Pangolin, and the Bengalese termed it the Reptile of Stone. The first to be noticed is—

THE SHORT-TAILED, OR FIVE-FINGERED PANGOLIN.‡

This is supposed to be the Phattage of Ælian, and much resembles Temminck's *Manis* from South Africa. It has a small head, which is pointed and long at the muzzle; the body is rather stout, and the tail is short, broad at the root. The back scales are in longitudinal rows, eleven in number, and they are smaller than those of the African kind. It has the under part of the body, head, and feet naked, and more or less hairy, and some long, fair-coloured hairs spring from between the scales. The middle claw of the fore-foot exceeds the others in size. They feed on white Ants especially. They are found in Bengal, Madras, and Assam.

A *Manis* with a tail as long as the body, and with the scales of the hind feet acutely pointed, and the front and hind claws nearly equal in size, is found in Sumatra and in Java. Finally, the other Asiatic kind, *Manis Dalmannii*, is found in the Himalayas, China, and possibly in Java.

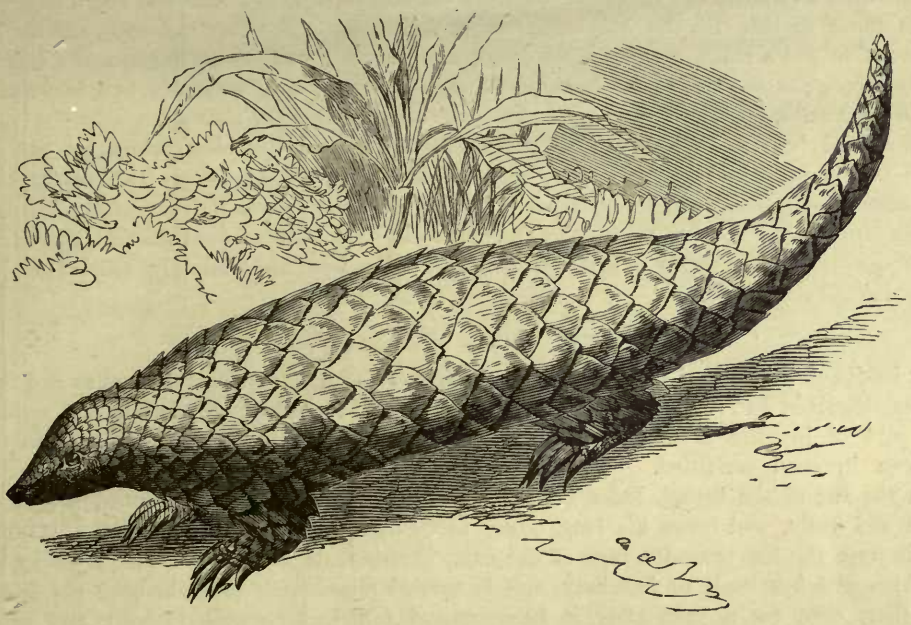
All the species of the genus *Manis*, whether from Africa or Asia, are absolutely toothless, and the Edentate peculiarity is perfect, for there are no back teeth. The tongue is worm-like, round, very long, and can be stuck out far from the mouth, and it supplies the want of the teeth, but from having this long organ and no back teeth, the palate and the skull are very long and conical. Being without masticating teeth, the lower jaw is very flat and simple, and there is no ascending ramus. The muscles of the lower jaw being of secondary importance, the arch (zygoma) of bone between the face and the ear is incomplete, and the outside ear is very small. But the organ of hearing is somewhat complicated, and there is a large space in the temporal bone which communicates with the internal ear, so that one tympanum is in communication with the other.

Much saliva is required to moisten the tongue, and the sub-maxillary glands are therefore very large, and reach down under the skin of the neck on to the chest. The stomach is usually, if not always, found to contain stones which the creature has swallowed. Of course it can hardly tell what may be on its tongue in the dark Ants' nest, and earth and stones are likely to rest on it and be swallowed, but the constant presence of these hard things may have something to do with the absence

* *Manis tetradactyla* (Linn.). † *Manis gigantea* (Illiger).
‡ *Manis brachyura.—Manis pentadactyla* (Linn.).

of the teeth, and the necessity of having a crushing material somewhere or other. The walls of the stomach are thin near the entry of the gullet tube, but towards the pylorus, or the right side end, the muscles are well developed, and the mucous membrane is very dense.

These animals use their claws for the purpose of digging holes in the ground, or in the Ants' nests, for the sake of food, and the position in walking is with the front claws bent under, so that the whole weight of the front of the body is felt on the back (or upper part) of the claws. The hind feet are placed flat, and the sole and under part of the claws sustain the hinder quarters. The joints of the five fingers of the fore feet are so arranged that they can bend downwards only, and indeed they are more or less permanently bent, being kept in that position by strong ligaments. This assists the digging powers of the claws, which are, moreover, forked at their points in some species, and the wrist is rendered very strong by having the joints between two of its bones abolished, and they are united by bone, as in the carnivorous animals. The bones thus united are the scaphoid and semi-lunar bones. Every structure in the creature's fore limbs tends to the promotion of easy and powerful digging,



FIVE-FINGERED PANGOLIN.

and as the motion of scratching the ground is directly downwards and backwards, the power of moving the wrist half round, and presenting the palm more or less upwards, as in the Sloths and in man, does not exist. In order to prevent this pronation and supination, the part of the fore-arm bone, the radius, next to the elbow, is not rounded, but forms part of a hinge joint. Finally, it is necessary to observe, that the middle claw is the longest of the five on all the extremities, and that as the animal does not require to reach over its head, there is no collar bone.

The long tail of the Pangolins, stumpy at the end in some kinds, has a considerable number of bones, usually twenty-six ; and the first of them joins on to the last of the back bones of the pelvis. This last, or sacral vertebra, unites on each side with the haunch bones (ischium), and there is no notch in the bone for the passages of the great nerves of the back of the leg, but a hole.

The thigh bone is flattened from before backwards, and the bones of the leg are wide apart, and all this gives extra powers to the muscles which have to direct the scraping and digging by the hind feet. The feet are solid and strong, and have not any of the inside turning and club-foot appearance of the Sloths, and the heel bone projects backwards.

There is an interesting peculiarity about the chest of the Pangolins, for the breast bone is very long, and the cartilage at its end is large, and has two long projections resembling those of the Lizards. The neck consists of seven vertebræ, and the back of thirteen, and there are three or four in the sacrum.

THE AMERICAN ANT-EATERS.

The adjective "long" may be applied to nearly all the structures of these animals. The tail, body, neck, head, snout, and tongue, and the hair are all very long, and the only things which are short are the ears. The observer is immediately struck with the curiously-shaped head, so narrow, low, and ending in a flexible and very slender snout, especially if the round tongue happens to be projecting out of the mouth, for it is longer even than the head, and is like a gigantic worm. The snout appears bent, and is made to look all the longer, by the eye being placed not far from the small ear. Then the huge bushy tail, flattened from side to side, as long as the body, has a fringe of very long and strong hair. The body itself moves on four powerful limbs, well clawed, and looks bulky from the quantity of hair on it, but usually it is thin. The animal, when it stands still, is higher at the shoulders than behind, and it rests on the sides of the fore-feet, where there is a callous pad, the claws being bent inwards and under, and not touching the ground with their tips. The under part of the hind feet bears the weight of the hind limbs. It is about four feet and a half in length from the snout to the tail, the tail being rather more than three feet in length, and the height is about three feet and a half. So long is the head, that it measures thirteen inches and a half from the ear to the snout, and the tongue can be projected for sixteen or eighteen inches, and is, when brought back into the mouth, bent so that its tip looks backwards towards the throat.

The animal belongs to a group of the Edentata (for it is toothless) which has the following genera :—One genus, which is now being considered, is *Myrmecophaga*—μύρμης (an Ant), and φαγεῖν (to eat)—a second is *Tamandua*, and the third is *Cyclothurus*, from κυκλωτός (rounded). The animals of this group represent in South America the Pangolins and Cape Ant-eaters of the Old World.

The species of the genus *Myrmecophaga*, which has been thus slightly alluded to, is called the Maned Ant-eater.

THE GREAT ANT-BEAR.*

The habits of this animal, which has been named Great Ant-Bear by the English and Spaniards, have been described as follows :—"The habits of the Great Ant-Bear are slothful and solitary; the greater part of his life is consumed in sleeping, notwithstanding which he is never fat, and rarely even in good condition. When about to sleep he lies on one side, conceals his long snout in the fur of the breast, locks the hind and fore claws into one another, so as to cover the head and belly, and turns his long, bushy tail over the whole body in such a manner as to protect it from the too powerful rays of the sun. The female bears but a single young one at a birth, which attaches itself to her back, and is carried about with her wherever she goes, rarely quitting her, even for a year after it has acquired sufficient strength to walk and provide for itself. This unprolific constitution, and the tardy growth of the young, account for the comparative rarity of these animals, which are said to be seldom seen, even in their native regions. The female has only two mammæ, situated on the breast, like those of Monkeys, Apes, and Bats. In his natural state the Ant-Bear lives exclusively upon Ants, to procure which he opens their hills with his powerful crooked claws, and at the moment that the insects, according to their nature, flock from all quarters to defend their dwellings, draws over them his long, flexible tongue covered with glutinous saliva, to which they consequently adhere; and so quickly does he repeat this operation, that we are assured he will thus exsert his tongue and draw it in again covered with insects twice in a second. He never actually introduces it into the holes or breaches which he makes in the hills themselves, but only draws it lightly over the swarms of insects which will issue forth, alarmed by his attack. 'It seems almost incredible,' says D'Azara, 'that so robust and powerful an animal can procure sufficient sustenance from Ants alone; but this circumstance has nothing strange in it to those who are acquainted with the tropical parts of America, and who have seen the enormous multitudes of these insects, which swarm in all parts of the country to that degree that their hills often almost touch one another for miles together.' The same author informs us that domestic Ant-Bears were occasionally kept by different persons in Paraguay, and that they had even been sent alive to Spain, being fed upon bread-and-milk mixed with morsels of flesh minced very small. Like all animals which

* *Myrmecophaga jubata.*

GREAT ANT-BEAR.

live upon insects, they are capable of sustaining a total deprivation of nourishment for an almost incredible time."

The Great Ant-Bear is found in all the warm and tropical parts of South America, from Colombia to Paraguay, and from the shores of the Atlantic to the foot of the Andes. His favourite resorts are the low, swampy savannahs, along the banks of rivers and stagnant ponds. He is found also frequenting the humid forests, but never climbing trees, as falsely reported by Buffon, on the authority of La Borde. His pace is slow, heavy, and hesitating; his head is carried low, as if he smelled the ground at every step, whilst his long, shaggy tail, drooping behind him, sweeps the ground on each side, and readily indicates his path to the hunter; though, when hard pressed, he increases his pace to a slow gallop, yet his greatest velocity never half equals the ordinary running of a man. So great is his stupidity, that those who encounter him in the woods or plains may drive him before them by merely pushing him with a stick, so long, at least, as he is not compelled to proceed beyond a moderate gallop; but if pressed too hard, or urged to extremity, he turns obstinate, sits up on his hind quarters like a Bear, and defends himself with his powerful claws. Like that animal, his usual, and indeed only, mode of assault is by seizing his adversary with his fore paws, wrapping his arms round him, and endeavouring by this means to squeeze him to death. His great strength and powerful muscles would easily enable him to accomplish his purpose in this respect, even against the largest animals of his native forests, were it but guided by ordinary intelligence, or accompanied with a common degree of activity. But in these qualities there are few animals, indeed, which do not greatly surpass the Ant-Bear, so that the different stories handed down by writers on natural history from one to another, and copied, without question, into the histories and descriptions of this animal, may be regarded as pure fiction. For this statement we have the express authority of Don Felix d'Azara, an excellent observer and credible writer, from whose "Natural

History of the Quadrupeds of Paraguay" we have derived the greater portion of the preceding account of the habits and economy of this extraordinary animal. "It is supposed," says Don Felix, "that the Jaguar himself dares not attack the Ant-Bear, and that if, pressed by hunger, or under some other excitement, he does so, the Ant-Bear hugs him and embraces him so tightly, as very soon to deprive him of life, not even relaxing his hold for hours after life has been extinguished by his assailant. It is very certain that such is the manner in which the Ant-eater defends himself; but it is not to be believed that his utmost efforts could prevail against the Jaguar, which, by a single bite or blow of his paw, could kill the Ant-eater before he was prepared for resistance; for even in so extreme a case, his motions are so slow and so heavy, that he takes some time to get himself ready, and besides being unable to leap, or to turn with even ordinary rapidity, he is necessarily forced to act solely on the defensive." The flesh of the Ant-eater is esteemed a delicacy by the Indians and negro slaves, and, though black, and of a strong musky flavour, is sometimes even met with at the tables of Europeans.

This large Ant-eater, grey in colour, with a black-coloured throat and a triangular spot, black in tint, ascending obliquely over each shoulder, has four claws on the fore limb and five on the hinder extremity. The claws are grooved underneath, and are not split or forked as in the *Manis*, and they, and especially the great middle claw, are protected by an expansion of bone from the last joint of the digits, or toes. This envelopes the base of the claw, except quite underneath, leaving the tip free to perform its office without endangering the tender base. The tips are protected, moreover, in the fore limbs by the position assumed during standing and walking, for they are then turned in and do not touch the ground; but this is not the case in the feet, for the Great Ant-Bears rest on their soles. Without teeth, and having an incomplete arch of bone between the cheek and ear bones, they possess a long palate, so long, indeed, that when the long nose cavity opens into the throat in the skeleton certain bones called pterygoid, or wing-shaped, form part of its boundary. This is unusual amongst the Mammalia, and Huxley observes that it is only found in some of the Whale tribe (*Cetacea*). Moreover, it is not noticed in any other vertebrate animals except the Crocodiles. The skull is very low and long, and the framework of the tongue is as important as that of the jaws. This kind of Ant-eater has imperfect collar bones. As in the other Ant-eaters there is in this one a very muscular condition of the right side of the stomach.*

THE TAMANDUA.†

The Tamandua is much smaller than the Great Ant-eater, and is, were it not for its long snout and tail, somewhat like a Sloth. It is nearly as large as one of these animals, and has a long head, small rounded ears, and small mouth. The body, some two feet in length, is rather short, and is covered with short, silky, or woolly shining hair, of almost uniform length. The fore limbs are very stout, especially above the elbow, and the hind ones rest on the rather long sole. The tail is about a foot and a half in length; it is stout at its root, and round and tapering to the blunt end, is minutely scaled, and covered in some places with short hairs. The fore claws are bent on the hand, and the animal walks on their outer and upper surface, using them also to clasp and to hang on in climbing. The tail is more or less prehensile. The colour of the hair and the markings varies much in the species, and in captivity the rusty straw-colour of the body becomes whiter; but there is a line of black on the upper part of the chest reaching over the shoulders and between them and the neck on to the back, and also several black patches over the tail and on the flanks.

The Tamandua is an inhabitant of the thick primeval forests of tropical America, and lives in Brazil and Paraguay. It is rarely found on the ground, but resides almost exclusively on trees, where it lives upon termites, honey, and even, according to the report of D'Azara, bees, which in those countries form their hives among the loftiest branches of the forest, and, having no sting, are more readily despoiled of their honey than their congeners of Great Britain. When about to sleep, it hides its muzzle in the fur of its breast, falls on its belly, letting its fore feet hang down on each side, and wrapping the whole tightly round with its tail. The female, as in the case of the Great Ant-eater, has but two pectoral mammæ, and produces but a single cub at a birth, which she carries about with

* It is certainly remarkable that the brain of this animal should present numerous convolutions, whilst the brain of the Sloth has barely any. The commissures of the brain are large, especially that of the centre, or corpus callosum, and also the anterior. The uterus is simple, the os is double, and the placenta is said to be discoidal.

† *Tamandua tetradactyla.*

her on her shoulders for the first three or four months. The young are at first exceedingly deformed and ugly, and of an uniform straw-colour.

The animal is called Cagouaré by the Guaranis, on account of the noxious and infected vapours of the forests in which alone it is found, the word literally signifying, in the language of those Indians, "the inhabitants of a stinking wood or marsh." Such at least is D'Azara's interpretation of the term, though it appears more probable that it may refer to the strong disagreeable odour of the animal itself, which, this very author informs us, is so powerful that it may be perceived at a very great distance, particularly when the animal is irritated. Tamandua is the name by which it is known to the Portuguese of Brazil; the French and the English call it Fourmilier and Little Ant-Bear.

THE TWO-TOED ANT-EATER.*

These little animals appear, at first sight, to resemble Sloths with tails; and their round heads, furry bodies, and two claws on the fore limb, add to the resemblance. They are essentially arboreal animals also, but they have long and useful tails, and live on insects. They hunt their insect prey in the forests of Costa Rica, Honduras, and Brazil. Their two-clawed hands are remarkable, for the rudiments of the thumb and little finger are hidden beneath the skin, and the claws are placed on the first and second digits. The third digit has no claw. There are four claws on the feet, so that in this arrangement the animal is peculiar amongst the Ant-eaters. It is not larger than a common Squirrel, and the general shape of the body is like that of a Tamandua on a small scale. Its whole length, from the snout to the origin of the tail, is but six inches, and of the tail, seven inches and a quarter. This is consequently rather longer than the body; it is thick at the root, and covered with short fur, but tapers suddenly towards the point, where it is naked and strongly prehensile. The muzzle is not so long, in proportion, as in the other two species; the tongue also is shorter, and has a flatter form; the mouth opens further back in the jaws, and has a much larger gape, the eye being situated close to its posterior angle; the ears are short, rather drooping, and concealed among the long fur which covers the head and cheeks; the legs are short and stout; and the hair, very soft and fine to the touch, is three-quarters of an inch in length on the body, but much shorter on the head, legs, and tail. The general colour is that of straw, more or less tinged with maroon on the shoulders, and particularly along the median line of the back, which usually exhibits a deep line of this shade. The feet and tail are grey.

This species is said to have four mammæ, two pectoral, as in those already described, and two others on the abdomen. It is reported, nevertheless, to have but a single cub at birth, which it conceals in the hollow of some decayed tree. The habits and manners of this little animal, hitherto very imperfectly known to naturalists, are well described by Von Sach, in his "Narrative of a Voyage to Surinam."

"I have had two little Ant-eaters, or Fourmiliers, which were not larger than a Squirrel. One was of a bright-yellow colour, with a brown stripe on the back, the other was a silvery-grey, and darker on the back. The hair of each was very soft and silky, a little crisped; the head was small and round, the nose long, gradually bending downwards to a point; it had no teeth, but a very long round tongue; the eyes were very small, round, and black; the legs rather short; the fore-feet had only two claws on each, the exterior being much larger and stronger than the interior, which exactly filled the curve or hollow of the large one; the hind feet had four claws of a moderate size; the tail was prehensile, longer than the body, thick at the base and tapering to the end, which, for some inches on the under side, was bare. This little animal is called in Surinam 'Kissing-hand,' as the inhabitants pretend that it will never eat, at least when caught, but that it only licks its paws, in the same manner as the Bear; that all trials to make it eat have proved in vain, and that it soon dies in confinement. When I got the first, I sent to the forest for a nest of Ants, and during the interim I put into its cage some eggs, honey, milk, and meat; but it refused to touch any of them. At length the Ants' nest arrived, but the animal did not pay the slighest attention to it either. By the shape of its fore-paws, which resemble nippers, and differ very much from those of all the other different species of Ant-eaters, I thought that this little creature might perhaps live on the nymphæ of Wasps, &c. I therefore brought it a Wasps' nest, and

* *Cyclothurus didactylus.*

then it pulled out, with its nippers, the nymphæ from the nest, and began to eat them with the greatest eagerness, sitting in the posture of a Squirrel. I showed this phenomenon to many of the inhabitants, who all assured me that it was the first time they had ever known that species of animal take any nourishment. The Ants which I tried it with were the large white termites upon which fowls are fed here. As the natural history of this pretty little animal is not much known, I thought of trying if they would breed in a cage; but when I returned from my excursion into the country I found them both dead, perhaps occasioned by the trouble given to procure the Wasps' nest for them, though they are here very plentiful; wherefore I can give no further description of them, than that they slept

TWO-TOED ANT-EATER.

all the day long, curled together, and fastened by their prehensile tails to one of the perches of the cage. When touched they erected themselves on their hind legs, and struck with the fore-paws at the object which disturbed them, like the hammer of a clock striking the bell, with both paws at the same time, and with a great deal of strength. They never attempted to run away, but were always ready for defence when attacked. As soon as evening came, they awoke, and with the greatest activity walked on the wire of the cage, though they never jumped, nor did I ever hear their voice."

All these Ant-eaters have great glands (sub-maxillary) for the purpose of secreting the sticky saliva, and the tongue is most movable, and wriggles like an eel in feeding on milk. The Little Ant-eater has a *rete mirabile* of blood-vessels.

Another Cyclothurus lives in Costa Rica, which is golden-yellow in colour, and silky in its hair. It has a broad black stripe on the back.

CHAPTER III.

THE ARMADILLO FAMILY.

The Armour-plates—How the Shields are formed—Their connection with the Body—Description of the Animals—Mode of Walking—Diet—Skeleton—Adaptation of their Limbs for Burrowing—Classification—THE GREAT ARMADILLO—Appearance—Great Burrower—THE TATOUAY—THE POYOU, OR YELLOW-FOOTED ARMADILLO—THE PELUDO, OR HAIRY ARMADILLO—THE PICHIY—THE PEBA, OR BLACK TATOU—THE MULE ARMADILLO—THE BALL ARMADILLO—Dr. Murie's Account of its Habits—Description—The Muscles by which it Rolls itself up and Unrolls itself—THE PICHICIAGO—Concluding Remarks : Classification of the Order, Fossil Edentates, the Allied Species of *Manis* in South Africa and Hindostan.

THESE South American animals are more or less covered with a hard bony crust, separated into shields and bands, which are more or less movable, owing to the presence of special skin-muscles. In the most perfectly armoured there are four distinct shields and a set of bands, a certain amount of motion being possible between their edges. Of the shields, one covers the head, another the back of the neck, a third protects the shoulders like a great cape, and the fourth arches over the rump like a half dome, and is, in some, attached by its deep structure to the bones of the hip and haunch. The movable bands cover the back and loins, and are between the third and fourth shields. The tail may further be invested by incomplete bony rings, and scattered scales, and others are distributed over the limbs. This covering is, according to Professor Huxley, strictly comparable to part of the armour of the Crocodile; and the Armadillos are the only Mammals possessing such structure. The shields and bands are formed of many scales, or scutes, which are ossifications of the skin, and they may be of many kinds of shape—four, or many-sided—being united by sutures, and they are incapable of separate motion. The shields and bands, however, vary much in their number, size, and perfectness in the different animals, which, being armoured, the Spaniards called Armadillos; and, indeed, the number of bands in the back and loin division varies in individuals of the same species. These bands cover the flanks, and, with the shields fore and aft, protect the limbs, which are often more or less hidden by a growth of hair. The bands, moreover, by being movable one on the other, enable the rest of the armour to accommodate itself to the motions of the body, so that some roll themselves up, as in a ball shape. There may be few or many bands present, and the extreme numbers are three and thirteen. The Armadillos are of different sizes, and whilst the smallest may be only ten inches in length without the tail, the largest are more than three feet long. The head is long, and broad at the neck, the ears are usually long, the neck is short, the body is long, round, and low, and the length of tail varies much in different kinds. Where the head shield joins that of the shoulders, there is a space for the movement of the short neck; but this is protected by a backward projection from the head shield. The throat, under parts, and thighs are not protected by armour, except here and there by small plates in the skin, or by a granulated state of it; and they are naked or hairy. Even between the bands on the back there are often long hairs, and the tail fits into a kind of notch in the last shield of the body, and its plates are close in almost all Armadillos, but not united. So that much more motion is given to it and to the body than might be expected by the muscles during their action beneath the more or less soldered bony skin. The flat top to the head, and the long muzzle, are useful to the Armadillos in their burrowing, and this is assisted by short and strong limbs armed with powerful claws. Some of the Armadillos are even capable of running with some speed; and the little Six-banded Armadillo, or Poyou, and the Matico, are very restless and active in captivity. With one exception, these animals move with the flat of their feet and hands on the ground; all have five hind claws, but there is some variation in the number of the fore claws, which may be four or five. They have simple cylindrical molar teeth, which, according to the species, are from seven or eight to twenty-five on each side of each jaw, and they are separate, standing apart from one another. Moreover, they are so arranged that when the mouth is closed, the upper teeth fit into the spaces between the under ones, and the under teeth into those of the upper, so that their grinding surfaces wear down into ridges. In one kind, there are some teeth in the pre-maxillary

BONES OF CLAW OF GREAT ARMADILLO.

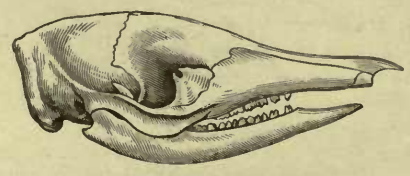
bones; but all the others have only molar teeth, which do not, however, go very far back, for there are none on the ascending ramus of the lower jaw. They are not, therefore, animals which prey upon their fellows, but are vegetable, insect, and probably carrion eaters. They dig and burrow, and their sense of smell is acute. This is assisted by the position of the nostrils in the long muzzle, for they are not at its tip, but rather underneath, so that they open downwards. In fact, the ends of the bones of the nose project in front of the pre-maxillary bones. The armour is doubtless useful against the attacks of their many carnivorous and reptile enemies; it assists them in burrowing, keeps off pressure, and may protect those which live in forests against a falling bough. They are passive creatures, mostly nocturnal in their habits, and their skeleton is strengthened in some parts in relation to its armour and its office.

Thus the spine of the second vertebra is tall and compressed, and reaches backwards over those of

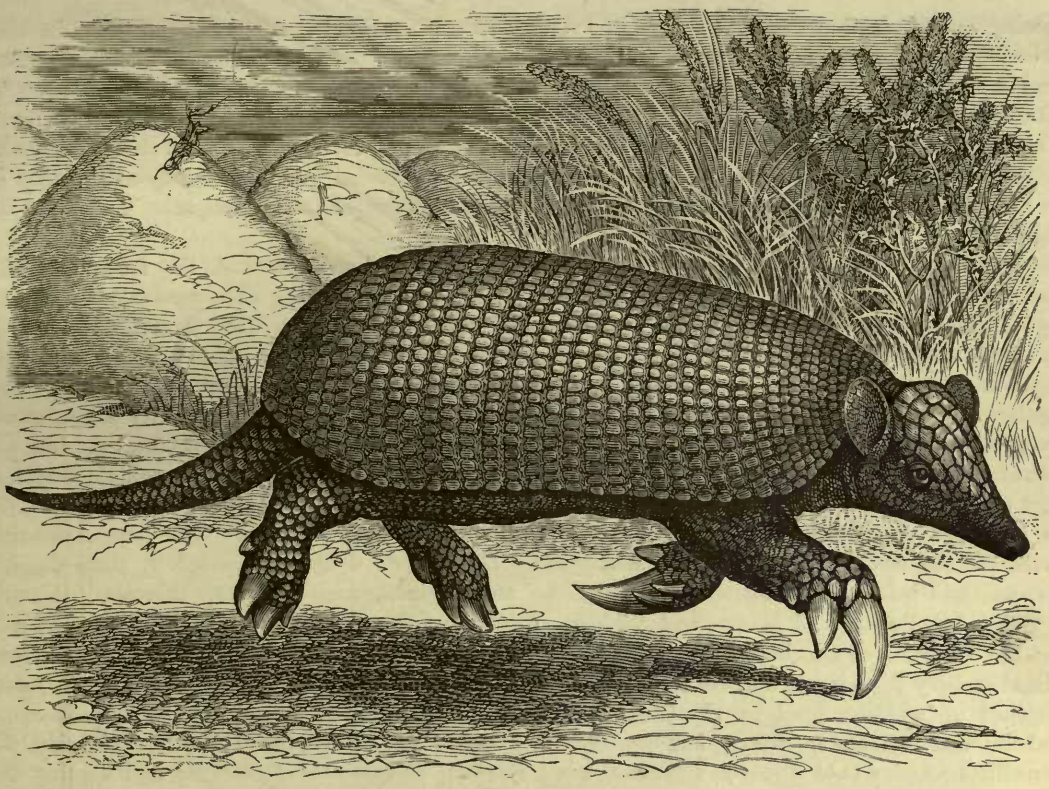
SKELETON OF THE ARMADILLO.

the third and fourth vertebræ, and it coalesces with them. The bodies of these vertebræ also join more or less solidly, and there are no (or very minute) spines on the last three cervical vertebræ. This gives a strange appearance to the skeleton, which is increased by the length of the spine of the first vertebra of the back (dorsal). In order to support the back shield, the projections from the back bones are greatly developed, and two side processes stand out on either side of the spinous one. Moreover, there is much fixity between the last dorsal and lumbar vertebræ, and the strong and long sacrum beneath the last shield is formed by the junction of the back bones of the root of the tail with the true sacral vertebræ. Finally, the transverse processes of some of the upper tail vertebræ are united to the pelvic bones. There is a corresponding strengthening of the chest, and a broad flat first rib accompanies an expanded condition of the upper part of the breast bone; and this bone is jointed with bony sternal ribs, which unite on the side of the chest with the ordinary ribs of the spine.

As they are rapid burrowers, the limbs are fashioned with a view of favouring this kind of life, the general skeletal peculiarities of the Edentata being more or less preserved at the same time. They have a collar bone, and the blade bone is long, rather narrow, and has a tall, long spine, and a kind of offshoot from the back edge. The humerus of the arm is short and robust, strongly marked by ridges and depressions for the great muscles of the shoulder and chest, and the fore-arm is characterised by the disproportionate size of its two bones. The ulna has a very long and stout elbow process (olecranon) for the attachment of the muscles, which can force the hand strongly on to and into the earth, and drag it out, and its length makes the whole bone twice as long as the radius. The thigh bone has a strong crest, arising from the great trochanter, and extending downwards nearly the whole length of the bone; moreover, the great trochanter has a large process on the middle of its outer edge. The bones of the leg are broad, arched, and united at both ends, and the heel bone reaches far back, in order to give strength to the squatting position taken up when the animal is burrowing. The eye is placed rather high in the head, is protected above by the outer edge of the head armour, and by some small surrounding scales. It looks as a rule outwards. The lower jaw is long, and has a back angle, sometimes of some size; the cheek bone unites to the temporal bone, and



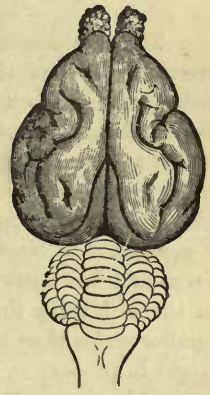
SKULL OF THE ARMADILLO.



GREAT ARMADILLO.

the arch is complete. In the face the intermaxillary bone is well developed, and there is often a crest of bone passing over the top of the skull from side to side over the occiput, which is in relation to the head armour. The brain is small; the back or little brain is not covered by the brain proper, whose convolutions and processes are few and simple. The olfactory lobes project.

These armoured, round-bodied, short-legged, great-clawed animals are numerous, and there are several species, which need not, however, be collected into more than two genera. But it is by no means easy to arrange those of the first genus—the True Armadillos, genus *Dasypus*—in any other than an arbitrary and very artificial classification. Usually they are grouped and separated by the relative number of digits or claws on the fore and hinder extremities; by the presence or absence of teeth in the intermaxillary bones; by their ability to roll up; and by the excessive or the small number of their teeth. The method of walking, whether on the sole or on the tips of the claws, and the number of the bands, have been partly employed in classification, but their number is often variable in individuals of the same species.



BRAIN OF THE ARMADILLO.

The Priodontes have but one species, which is readily distinguished by its superior size, besides by its great number of teeth, of which there are from twenty-two to twenty-four small ones on each jaw on each side, making from eighty-eight to ninety-six in all.

THE GREAT ARMADILLO.*

This is an inhabitant of Brazil, and of the northern parts of Paraguay and of Surinam, and is a dweller in the forest, being never found far out on the plains. The head is seven inches and a half long, and the ears, usually pointed and laid backwards, are not quite two inches in length. The head and body, without the tail, measure three feet and some inches, whilst the thickly-rooted but rapidly-

* *Dasypus gigas* (Cuvier).

tapering tail is about a foot and a half in length. Hence the head is small for the body in this Armadillo, and the forehead is protuberant, and the face is very tubular and cylindrical-looking. The shoulder and croup shields are not expanded and solid, but consist of nine and eighteen rows of plates respectively, and the intermediate part of the body has twelve or thirteen movable bands, each of which is made up of rectangular scales, or scutes, about half an inch square. The circumference of the root of the tail is upwards of ten inches, and the organ is covered with plates, disposed in rings at the root, and not farther down, but forming spiral or crescent-shaped lines throughout the rest of its length.

The Great Armadillo is a persevering and most rapid burrower, and the fore limb and hand are singularly modified for the purpose of enabling rapid digging and removal of the soil. The olecranon process of the ulna is enormous, and the muscle of the deep flexor or tendon of the claws is ossified and turned into a hand bone. The metacarpal bones of the thumb and first finger are small, and so are the slender digits, but that of the middle finger is irregularly rectangular, and is broader than long, and the digit which it supports is extraordinarily short, stout, strong, and broad. Its corresponding bones of the fourth finger are similarly formed, but are somewhat smaller, and the fifth finger is very small. The nail phalanx of the middle finger is large and strong, being curved *outwards*, and having a large horny hood, or core, at its base, for the lodgment of the claw. There are five claws on the hands and feet, and the Armadillo moves on the flat of its feet, being plantigrade. There is no doubt that, aided by these digging weapons, and being of considerable stoutness, the animal makes long and deep burrows. It feeds on roots, fallen fruit, and insects, and there is a story that it seeks carrion, and it used to be said that the collectors of Cinchona bark in the dense forests, when they lost a companion by death, were obliged to bury the body in a grave surrounded with a double row of stout planks, to prevent its being scratched up and devoured by the Great Armadillo. Planks must be scarce, however, in those localities, and difficult to carry; and probably there are other inhabitants of the woods besides the Armadillos which would discover and drag out a corpse. To assist the scratching and digging, the soles of the feet are partly covered with flat scales.

The Kabassous have the fore and hind extremities furnished with an equal number of (five) fingers and toes respectively, but the number of teeth is, altogether, from thirty to forty.

THE TATOUAY.*

This Kabassou has the five fingers disposed obliquely; and the great middle and fourth claws resemble those of the gigantic Armadillo. It is named in allusion to its tail, which is more or less naked, and nearly uncovered with rings or plates, so that it has not the usual tube-like protection, or beautifully ornamented crust seen in some Armadillos. The tail is about seven inches and a half long, and is round and pointed, having only a few hard crusts beneath, near the outer third, where it often trails on the ground. The rest of its root is covered with soft brown fur, interspersed with a few stiff short hairs on the upper surface. The ears are large, being nearly two inches in length, and they form a segment of a circle in figure. The body is round, and the shields of the shoulder and croup have seven and ten rows of scales respectively, each scale forming an oblong rectangle, those near the root of the tail being the largest. The movable bands are thirteen in number, and are composed of much smaller scales than those of the shields, and they have a nearly square outline. The head is long and larger in proportion than that of the Great Armadillo, and it has not the very cylindrical appearance noticed in that and some other species. The arrangement of the claws resembles that of the Great Armadillo, whose they almost equal in size. The female has two pectoral mammæ.

It inhabits Guiana, Brazil, Peru, Paraguay, and Surinam, and but little is known of the habits of these Armadillos. They burrow easily and rapidly, and their great claws enable them to grasp the earth, and fix themselves so thoroughly that a great amount of exertion is required to pull them out of a burrow. They live on insects and on vegetable matters.

The Encouberts of Cuvier have five toes on the fore and hinder extremities, and nine or ten teeth

* *Dasypus Tatouay* (Desmarest).

on each side of the jaws, and there are two teeth in the intermaxillary bones of the upper jaw, representing the incisor teeth of ordinary Mammals, and thus forming an exception, not only to the other Armadillos, but even to the order of *Edentata*, as represented in the recent period.

THE POYOU, OR YELLOW-FOOTED ARMADILLO.*

This little Armadillo, which in captivity and in the natural state is remarkable for its boldness and restlessness, is a native of Brazil and especially of Paraguay, where it is common. It has a large, flat, nearly triangular top to its head, the face is short, the muzzle obtuse, and the ears erect and of moderate size. It has sharp little eyes. It measures about sixteen inches from the nose to the tail, and this is about seven or eight inches long. The number of movable bands is often six, but this is not the invariable number, for there may be seven or eight. The tail is surrounded, at its base, with three or four bony rings, and throughout the rest of its length is nearly covered with regular tuberculous

POYOU.

scales, the separations between the bands showing some long bristly grey hairs. The body is flat and broad, and has short legs, and the creature runs with a very active and determined gait. It is a strong little thing, and it is said that when it is chased, it will often get away from a man by sheer speed and activity. When any noise is made at the entrance of its burrow, or if it is teased by spectators around its cage, it comes forth and grunts like a Pig, and looks at the disturber with a bold inquiring look. When it is attacked it is powerless, and seems incapable of making any defence, but it retreats to its burrow, and getting to the bottom of it, digs deeper still. Its power of burrowing does not seem to be much diminished by the limited rotation of the fore-arm, to which there is no pronator quadratus, but a well-developed pronator teres.

The Poyou feeds much on carrion, and for this reason its flesh, though fat, is never eaten by the inhabitants of European origin, though the Indians make no distinction in this respect between it and other Armadillos. When it stops or rests, it has a custom of squatting close to the ground like a Hare on her form, and in this position the great breadth of the body becomes apparent.

The hinder shield has two hairs on the hinder side of each of its dorsal scales, and the under part of the body has scattered bristles on it. The female has two pectoral mammæ.

* *Dasypus sexcintus* (Linn.).

The next two Armadillos to be noticed were formerly included in the same group as the Poyou, but as they have not the incisor teeth on the intermaxillary bones, they are placed in the sub-division *Euphractes.*

THE PELUDO, OR HAIRY ARMADILLO.*

The long, silky, half bristly, abundant black hairs of this little Armadillo are the principal characteristics, which separate it, so far as its external construction is concerned, from the Poyou just noticed. It is smaller, however, the head measuring nearly four inches in length, and the whole body about two inches less than *Dasypus sexcintus.* The ears are long, large, and elliptical, and are pointed outwards, and the muzzle is broad. The forehead is broad and covered with rugged scales. The bands are six or seven in number, and the border of the shield, as well as that of the movable bands below, is indented in a remarkable manner, and forms sharp, regular points. There are eight teeth on each side, above and below, and the body, hairy as it is, is much scaled interiorly and on the limbs. The tail is long and slender, and only hairy at the root. This species does not inhabit Paraguay, nor probably is it found in the Brazils, but it exists in multitudes in the Pampas north of the Rio Plata, and Mr. Darwin noticed it in Chili. Its habits, according to that most accurate observer, are nocturnal, but D'Azara, to whom natural history owes very careful descriptions, states that "in an expedition which I made into the interior, between the parallels of 35° and 36° south latitude, I met with vast multitudes of this species of Armadillo, so that there was scarcely an individual of the party who did not daily capture one or two at least; for, unlike the Poyou, which moves abroad only at night, this animal is to be found at all times, and if alarmed, promptly conceals himself, if not intercepted. In March and April, when I saw them, they were so extremely fat that their flesh surfeited and palled the appetite; notwithstanding which, the pioneers and soldiers ate them roasted, and preferred them to beef and veal. This Hairy Armadillo, like others of the genus, has undoubtedly a very acute sense of smell, since it scents the carcases of dead Horses from a great distance, and runs to devour them; but as it is unable to penetrate the hide, it burrows under the body until it finds a place which the moisture of the soil has already begun to render soft and putrid. Here it makes an entrance with its claws, and eats its way into the interior, where it continues feasting on the putrid flesh, till nothing remains but the hide and bones, and so perfectly do these preserve their position, that it is impossible, from a mere external view, to anticipate the operations which the Armadillos have been carrying on within." The same author states that this species never constructs burrows to reside in, that it avoids low, damp situations, and is found only on the dry upland plains. Probably there is more than one Hairy Armadillo.

THE PICHIY.†

This little Armadillo is only fourteen inches long, tail included; its scaling is very handsome, and there are six or seven bands according to the individual and age. The head is covered with close scales, which are elliptical behind, and concealed under the others in front, and the whole top has a triangular outline, hiding the eye much. The scales on the front shield are large, and are hexagonal or pentagonal, and the croup shield has the angular endings noticed in the last species. The scales of the bands and of the shields generally are beautifully ornamented with lines, depressions, and little tubercles, which are more or less concentric. There is some hair on the long neck, and on the legs and tail. The five digits and claws on the fore limbs are moderately developed, for the thumb is very small, and the fourth finger only a little longer. But the index is long, with a short claw, and the second has a stouter and longer claw, and the third is shorter. It has a slender snout and small ears.

Mr. Darwin writes that it "prefers a very dry soil and the sandy dunes of the coast of Chili, where for many months it can never taste water. In soft soil, the animal burrows so quickly that its hind quarters would almost disappear before one could alight from one's horse." It also inhabits the Pampas to the south of Buenos Ayres, and extends from 36° lat. southward to the confines of Patagonia. It inhabits burrows, to which, however, it does not confine itself during the day. Its flesh is said to be remarkably tender and well tasting. It is a hardy species, and can live in the dreary solitudes of Port Desire on the east coast.

* *Dasypus villosus* (Desmarest). † *Dasypus minutus* (Desmarest).

The Cachicames, another group of Armadillos, were so called after the Indian name for a black kind, which has a very long tail, and which is the type of it.

The two kinds included in the group have four fingers, and five toes, which are separate, and the backs of the feet are round and covered with scales. The claws are conical, and the animal walks, as it were, on the toes more than on the sole, being thus digitigrade. The teeth number about eight on each side above and below.

THE PEBA, OR BLACK TATOU.*

This Armadillo has a very wide geographical range, extending from Texas, through Central America to Guiana, Brazil, and Paraguay, and a variety called *Dasypus Kappleri* inhabits Surinam. It has great ears, which are long and placed very close together, and the muzzle at the end of the long, tapering face is not unlike that of the snout of a Hog in shape. The head is small, long, and straight, but the mouth is large. There are eight teeth on both sides of both jaws. The body is hairy below the shields and bands, which are largely developed. Then the neck and shoulder shield extends far back and comes as low as the elbow, and is composed of numerous scales disposed in many concentric rings, having the concavity in front, the first embracing the neck in its curve. The croup shield extends from the back to the origin of the tail, and reaches as low as the knees, and the concavity of its rings is turned towards the rear, the last embracing the tail. These scales are hexagons. Between the shields the bands are marked with zigzag lines forming very acute angles, and in some degree gliding over one another according to the movements of the animal. Out of fourteen specimens, two had six, one had seven, seven had eight, and there were four with nine bands; the full-grown ones have the greatest number. The head shield descends from the ears to the muzzle, and covers the cheeks as far down as the eyes, and there are small, interspersed, detached scales over the throat, the under jaw, the legs, and feet. The body is sixteen inches long, and the tail is nearly as long—fourteen inches—and is stout at the root. One variety of the species has some of the rings of the tail soldered into a case, which is used as a horn by the Indians. It is a timid, nocturnal animal, tolerably swift-footed and very expert in burrowing. It is never found in the woods, but delights in the open plains and cultivated fields, and is much hunted on account of the delicacy of the flesh, which, when roasted in the shell, is fat, and something better than Sucking-pig in taste. These long-tailed Armadillos bury garbage and flesh in their burrows, and eat it at their leisure.

Another species of this group is the Mule Armadillo (*Dasypus hybridus*, Desmarest), which has long, straight ears and a short tail. It roams farther north than the other kind, and is common on the Pampas, and is not nocturnal, nor does it burrow very easily. The female has from eight to twelve young at a birth, and the individuals of a litter are often of one sex.

The Armadillos of all kinds, it is said, only have one litter a year, and then the young are numerous, but the mother has never more than four teats, and many have only two.

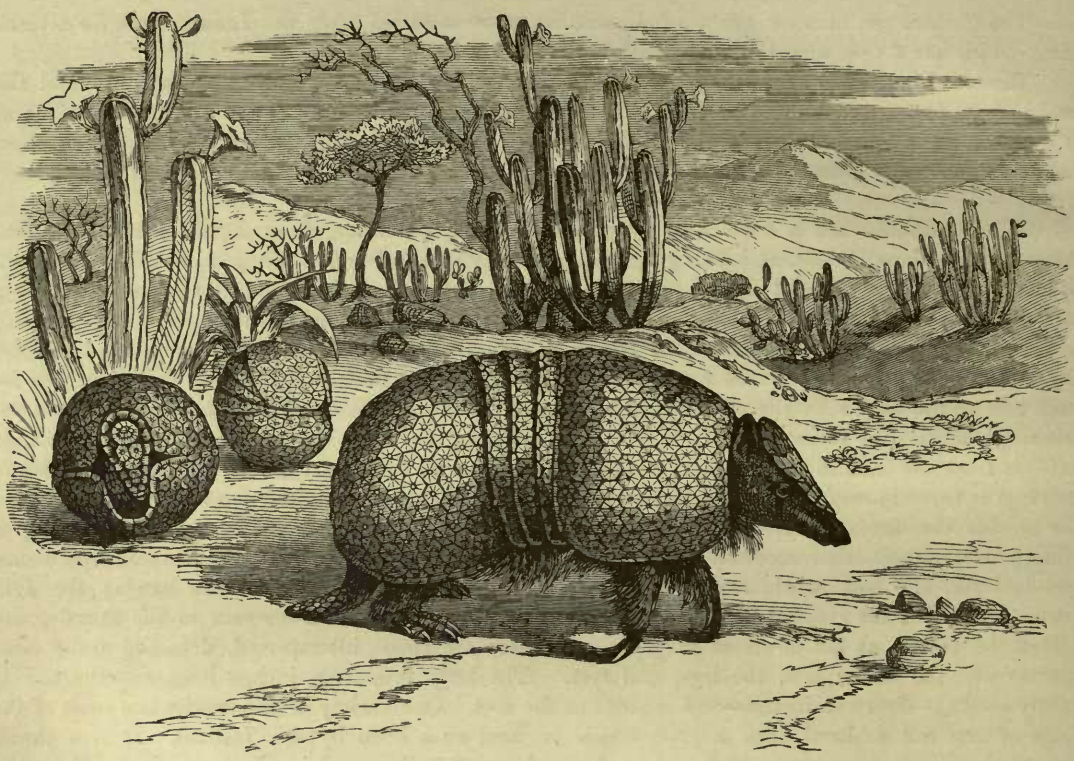
The last group of the Armadillos, the *Tolypeutes*, contains some remarkable species, which have the power of rolling themselves up as in a ball-shape, and they walk in a most extraordinary manner on the tip of long and powerful front claws, and also on the flat and tip of the hind ones.

THE BALL ARMADILLO.†

This is a small and very beautifully ornamented Armadillo, which has three free central bands and a short tail, with large fore and aft shields. It rolls itself up on the slightest alarm, so that the great shoulder and croup shields meet, the head and tail fitting in exactly, in front, so as to close up the body very safely. The little animal, which is rarely more than fifteen inches long, and has a tail of a couple of inches in length, is found in Brazil, Paraguay, and Buenos Ayres, and its walking on the long, stout claws of the fore legs gives it a very curious and unsteady appearance.

It is an active, sprightly, light-footed little thing, according to Dr. Murie, and is constantly on the move, going here and there with much vivacity. Poising itself on tiptoe, it trots backwards and forwards as if on some urgent errand. In captivity the food was raw meat, boiled eggs, and bread-

* *Dasypus Peba* (Desmarest). † *Dasypus* (*Tolypeutes*) *apar* (Geoffroy).



BALL ARMADILLO.

and-milk. In the forest land, where it dwells along with its fellow armoured creatures, it has the advantage of being able to curl itself up, and to present no tangible part of its body to the host of mischievous Monkeys of its locality. The other Armadillos, when retiring to their holes, are often set upon by their lively quadrumanous neighbours, and are dragged out by the tail with great gusto; but the little Tolypeutes curls himself up and laughs at the disappointed Monkeys, who can find nothing to pull at about him.

The shoulder shield comes down like a flap, far in front, and the croup extends behind in the same way, and they and the bands have large scales, which are very pretty in shape and ornament. The shields are very stout, and so is the skeleton within. The fore foot has three large clawed toes, on the tips of which the animal walks. The thumb of the fore extremity is to be seen in the skeleton, but is not always visible in the skin, and it is very small and high up; the index is long, and the claw also, and it is slightly bent, but sharp at the tip. The next claw is the largest and longest, and has a cutting edge at the back and outer part, and the point is sharp. The next digit is smaller. In the hind foot there are five toes, one being high up and rudimentary, and the second and third having broad, flat, curved, short nails, the third being the greatest. The fourth nail is smaller, and they are all placed more or less flatly on the ground.

The shell of this Armadillo is blackish-brown, and the skin between the central bands is bald and smooth. There are nine back teeth on each side in both jaws, and there are none in front. The muscles which enable this Armadillo to bring its tail and nose together and to form a ball shape, are not simply expansions of the common muscular tissue, which exists deeply in the skin in so many animals, but are special structures. The most important are in relation to the position of the head, neck limbs, tail, and the shields and bands, when the body is about to be and while it is being rolled up; and these roller-up muscles are so arranged as to permit of the large liver and other internal organs not suffering pressure during their natural or temporary displacement. On the other hand, the unrollers act when the body and bones are in the rolled-up condition. The muscles of the back are very tendinous, and to a degree they unroll the animal, but this is also performed by muscles which are attached underneath the first movable band of armour, and to the front part of the spine of the blade

bone; this will tend, when it contracts, to pull out the legs and protrude the fore part of the body, the centre being still rigid. Another drawer-back of the bladebone assists in this action, and it is inserted into the front or chest shield. The rolling up is done by the action of muscles which draw the nose down, so as to make the long head at right angles to the neck; then the fore-legs and bladebones are drawn in and up. At the same time, the muscles which pull down the tail act on the hind shield, and draw it down and forwards. The legs are pulled up, and then a great muscle, which is largely attached to the front and hind shields, and has a tendon-like expansion in the middle of its course beneath the movable bands, contracts and pulls front and stern together. The muscles of the loins, which in jumping animals bring the spine to a curve, do not act, and indeed are excessively small. The chief bend in the back is between the second and third lumbar vertebræ. (Murie.)

GENUS CHLAMYDOPHORUS.—THE PICHICIAGO.*

This is an Edentate animal, resembling the Armadillos more than any others, and is about six inches in length. It has a conical-shaped head, a large full chest, short clumsy powerful fore limbs,

PICHICIAGO.

with four great nails rising gradually one above the other, the external shortest, and broadest; and the whole so arranged as to form a sharp-cutting instrument, rather scooped, and very convenient for progression under ground. The back and croup are broad and high, and the tail is small. The hind legs are weak and short, the feet being long and narrow, and there is a well-defined heel. The foot is arched, the toes are separate, and the nails are strong. The whole surface of the body is covered with fine silk-like hair, which covers over the limbs on to the palms. But the most striking peculiarity is the long-banded shell, which is loose as it were throughout, being attached to the back immediately above the spine by cellular tissue. It rests on two knobs on the frontal bones, and these are the great attachments of this important covering. There are twenty-four bands and no separate shields, and their consistence is somewhat more dense than leather of the same thickness. They are composed of scales or plates of geometrical form, and the bands are separated by skin. There is a notch in the last band for the tail, and the free inferior edges of the bands are everywhere fringed with silky hair. This elongated band structure is moved, to a certain extent, by two broad thin muscles, which are beneath it, on the back, and each of which divides, on approaching the shoulder, into two portions, one being attached to the bladebone, and the other to the occiput.

The ear is hidden by hair, and is small; so also is the eye, which is black. The nostrils open downwards, at the inferior border of a large cartilage. The mouth is small, and there are eight teeth on both sides in both jaws. They are simple molars, and are separate and cylindrical. The head is large behind, and the jaws come almost to a point, and the lower has a long ascending ramus. A

* *Chlamydophorus truncatus* (Harlan).

great passage for the spinal cord, and the two processes on the frontal bone, add to the curious appearance of this "bumpy" skull. The pelvis is remarkable in its structure, and is open in front.

Some of these animals have the bands of the armour not attached, as has been mentioned, to the muscles of the back and to the head, but have them adherent to the skin of the back to the edge; and the sides and under part of the body are then covered with woolly hair. These are the largest animals of the two, and are found in Bolivia. The others are from Mendoza and Chili. These curious animals live, partly, mole-like lives.

From what may be gleaned by reading the previous pages about the Edentates, it will appear that the order is a very remarkable one, and that it is interesting on account of the different external appearance of the species, their diverse modes of life, and singularly restricted localities. Evidently, there has been much degeneration in some of the anatomical characters of many of the species, and especially in those whose foot bones and neck vertebræ have joined more or less. The singular resemblance which some species present, in various points of their anatomy, to the lower animals, is very interesting, as is also their wonderful relation, in points of structure, with a number of extinct Edentata, most of which were gigantic.

The Edentata, called also Bruta by Linnæus, form an order, the characters of which are, that there are teeth of one or two kinds all very similar, and often wanting. The incisors are not developed except in one group, and the rest have either molars which are separate, and numerous and simple, or there are none. The extremities are clawed, and the tongue is more or less elongated. The great groups of this order are the *Tardigrada*, or slow movers, which have a short face, long limbs, and small tail, and the body is covered with crisp hair; and the *Effodientia*, or diggers, which have long faces and worm-like tongues, with short limbs.

The Sloths form the only family of the Tardigrada, and the Effodientia are divided into the genera *Manis*, the scaly Ant-eaters; *Dasypus*, the Armadillos; *Chlamydophorus*, the Pichiciagos; *Orycteropus*, the Ant-Bears; and *Myrmecophaga*, the American Ant-eaters. The Sloths form three genera —*Cholœpus*, *Bradypus*, and *Arctopithecus*. Amongst the Ant-eaters, the genus *Manis* may stand alone. The genus *Dasypus* may be divided, for the sake of convenience, into the subdivisions Priodontes, Kabassous, Euphractes, Cachicames, and Tolypeutes. The other genera need no subdivision.

The fossil Edentata are mostly gigantic, and formerly lived in Europe and in the Americas. The European kinds would, were they now living, belong probably to the group of Pangolins, and they are placed in the extinct genera *Pervatherium*, *Macrotherium*, and *Ancylotherium*. In the Pliocene deposits of North America, there are large Edentates belonging to the genus *Morotherium*, and the previous Miocene deposits contain *Moropus*. The later, or Post-Pliocene strata of North and South America, contain species of *Mylodon* and *Megalonyx*, *Megatherium*, *Scelidotherium*, *Cœlodon*, and *Sphenodon*; they constitute a group of Terrestrial Sloths—the Gravigrada. In Cuba, the fossil huge Gravigrade Sloths are of the genera *Megalocnus* and *Myomorphus*. The Armadillo group are found fossil in South America, and the genera are *Chlamydotherium*, *Euryodon*, *Heterodon*, *Pachytherium*, and *Schistopleuron*. The modern genera are found with these, and the gigantic Armadillo-like animal, the Glyptodon, lived contemporaneously with the others, and possessed many strange peculiarities in its skeleton. The Ant-eaters are represented by a fossil form called *Glossotherium*. The oldest Edentates of the American Continent are found in North America, unless there is a Miocene group of them in South America, which is by no means an improbable supposition. The European Ant-eaters now found fossil lived in the Eocene, Miocene, and Pliocene ages.

With regard to the discovery of recent and closely-allied species of *Manis*, in South Africa and Hindostan, it may be said that they are relics of the old forms of the intermediate and now sunken land, between Eastern Africa and India, which existed before the last upheaval of the Himalayas. The evident structural affinity between the Effodient Edentata of South America and Africa, although the genera are different, adds to the interest of the corresponding, and in some instances greater, resemblance of many African and South American fresh-water fish and plants. The geologist looks back in the remote ages of the globe, when the great land surfaces and seas of the world were rather across the earth than in their present longitudinal position, in order to explain this remarkable similarity.

P. Martin Duncan.

UNIV. OF
CALIFORNIA

GREAT KANGAROO.

ORDER MARSUPIALIA, MARSUPIAL OR POUCHED ANIMALS.

CHAPTER I.

SUB-ORDER MARSUPIATA.—THE KANGAROO AND WOMBAT FAMILIES.

THE GREAT KANGAROO—Captain Cook and the Great Kangaroo—Habitat—Appearance of the Animal—Marsupials separated from the other Mammalian Orders, and why (Footnote)—Gestation and Birth of Young (Footnote)—Mode of Running—The Short Fore Limbs—The *Marsupium*, or Pouch—Head—Dentition—Peculiarities in the Teeth—Hind Extremities—Foot—Great Claw—How the Erect Position is maintained—Whence their Jumping Power is derived—Other Skeletal Peculiarities—Kangaroo Hunts—Becoming Rarer—Mode of Attack and Defence—Hands—Bones of the Fore Limbs—Skull—Stomach—Circulation of Blood—Peculiarity in Young—Nervous System not fully developed—Brain—The Baby Kangaroo in the Pouch—THE HARE KANGAROO—THE GREAT ROCK KANGAROO—THE RED KANGAROO—THE BRUSH KANGAROO—THE BRUSH-TAILED ROCK KANGAROO—THE COMMON TREE KANGAROO—THE KANGAROO-RATS—Characteristics—THE RAT-TAILED HYPSIPRYMNUS—Description—THE WOMBAT FAMILY—THE WOMBAT—Peculiarities—Description—Habits—Teeth—Skeleton.

I. THE KANGAROO FAMILY.*—THE GREAT KANGAROO.†

IN the year A.D. 1770, the great circumnavigator, Captain Cook, was on the coast of New South Wales repairing his ship, and a party of sailors were sent on land, to procure food for the sick. They saw an animal whose description tempted Cook himself, and also Mr. Banks (afterwards Sir Joseph Banks), to land and go in pursuit of it the next day. The animal was seen in company with others of its kind, and its short front limbs, great hind legs, and huge tail, and the tremendous hops it made in its very fleet course, quite bore out the statements of the astonished crew. They had seen, for the first time, the Great Kangaroo in its wild condition and on its own ground. Soon afterwards a specimen was shot, and notes were made about the creature, and some skins were brought over to Europe.

The animal has now become familiar to the civilised world. It is, however, gradually receding before the Australian colonist and squatter; but formerly it roamed all over the plains of New South Wales, Southern and Western Australia, Queensland, and Van Diemen's Land, with only the aborigines for its enemies. It is called Bundaary and Bullucur by the natives of the Liverpool range and Murray, and the name Kangaroo is a mistaken native one.

On looking at one of the Great Kangaroos in some menagerie or zoological garden, the first peculiarities that strike the eye are its small fore limbs, its very large and long hind ones, and the great and thick tail. The smallness of the head, which has rather long ears, and a long dusky brown muzzle, the length of the body, and the comfortable grey-brown, thick, shortish fur, are then noticed. But the principal fact which impresses all these things upon the visitor, is that the female may have a little Kangaroo with its head poked out of a kind of pouch in the under part of the body. Sometimes the little one jumps out and gets in again if it is frightened, and the old one moves, hops, and jumps about, with its portable nursery, with the greatest ease.‡

Sometimes the Kangaroos may be seen feeding, and then the awkwardness of their gait becomes

* The *Macropodidæ*.

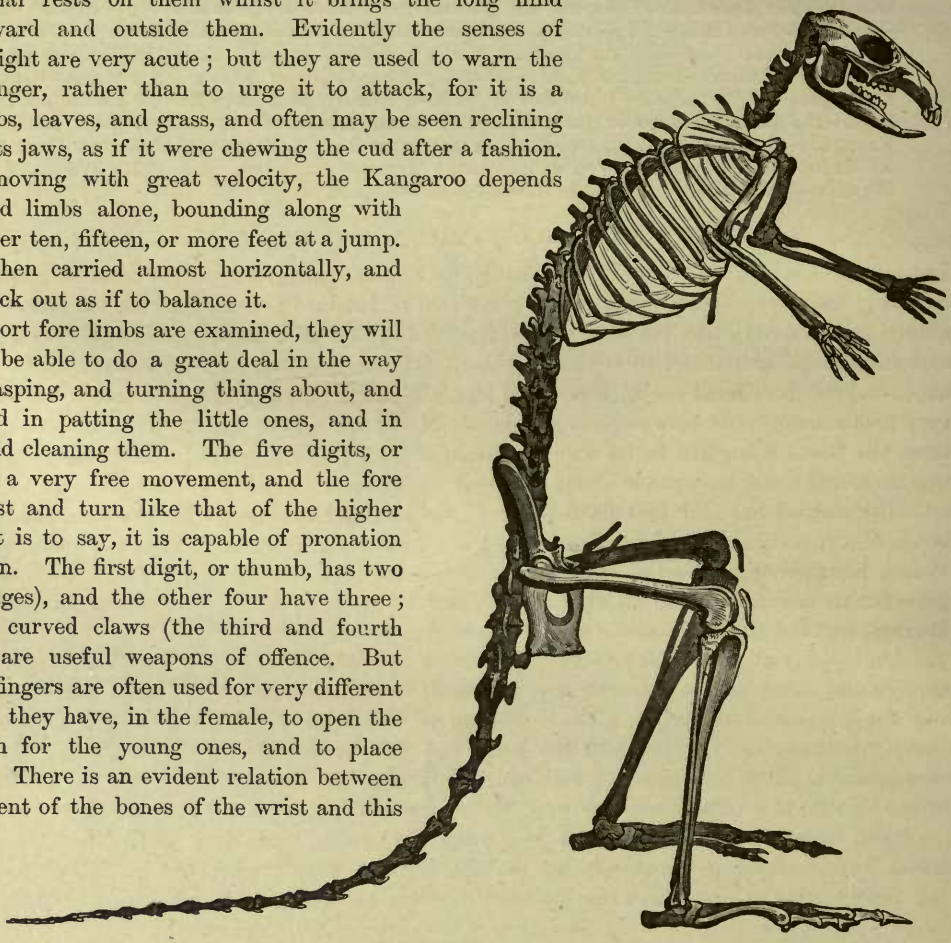
† *Macropus giganteus* (Shaw).

‡ The presence of the pouch, or marsupium, containing the teats, involves many structural and physiological peculiarities which separate the Marsupialia, in a classificatory sense, from the rest of the Mammalia. The Great Kangaroo, which may be considered a fair example of the Marsupials, has in the female a set of skin muscles, around the pouch, beneath the skin, which close it. The milk, or mammary gland, has four long, slender teats in the pouch, and beneath the skin of it is a muscle called the cremaster, which is largely developed. It spreads over the surface of the gland, and its action is to squeeze it and to force out the milk through the teat. There is thus protection for the young, and milk is given forth, without the effort of the young in sucking. The reason for this is obvious. The Great Kangaroo, which is often as tall as a man, is pregnant for about thirty-nine days only, and then a little one, not bigger than a thumb, is born; it is not completely formed, and is blind and cannot move itself. The mother places it in her pouch, and it fixes on to a teat, where it hangs for about eight months, and then it begins to look out of the pouch. The duration of the life of the young in the womb is thus very small, and it has no placenta there, which in the other and non-marsupial Mammalia forms the life-union between the mother and the offspring before its birth. Thus, the Marsupials form one great group of Mammalia which are "implacentalia," without placentas or "after-births," and all the other Mammalia are "placentalia," and have this link between mother and young. In all the Mammalia hitherto described the young come into the world by a single passage. In those now under consideration (the Marsupialia) there is a double passage, and the womb is separated into two portions, being double; so they are termed Didelphia. The marsupium has two remarkable bones more or less in relation to it, and all animals thus furnished are termed Marsupialia, and they form two sections or sub-orders—(1) The Marsupiata proper, with marsupial bones, mostly with pouches, and with inflected lower jaws. (2) The Monotremata, which have marsupial bones, depressions in the skin, when suckling, like ill-developed pouches, and beak-like jaws in front, which are not inflected.

evident; for the small fore legs and curious paws are on or very close to the ground, whilst the back part of the body is raised up by the long hind legs, and, as it were, balanced by the great tail. These hind legs seem to do nearly all the running, or rather jumping, both being used together; and the tail is of use in supporting the long body when the animal suddenly raises itself up straight, and squats on its hind quarters. The small front legs then appear quite stunted, and the ears stick up, and the small head is held straight. But in slow walking, the fore feet are placed on the ground, and the animal rests on them whilst it brings the long hind quarters forward and outside them. Evidently the senses of hearing and sight are very acute; but they are used to warn the animal of danger, rather than to urge it to attack, for it is a feeder on herbs, leaves, and grass, and often may be seen reclining and moving its jaws, as if it were chewing the cud after a fashion.

When moving with great velocity, the Kangaroo depends upon the hind limbs alone, bounding along with great ease, over ten, fifteen, or more feet at a jump. Its body is then carried almost horizontally, and the tail is stuck out as if to balance it.

If the short fore limbs are examined, they will be noticed to be able to do a great deal in the way of holding, clasping, and turning things about, and they are used in patting the little ones, and in embracing and cleaning them. The five digits, or fingers, have a very free movement, and the fore arm can twist and turn like that of the higher animals; that is to say, it is capable of pronation and supination. The first digit, or thumb, has two joints (phalanges), and the other four have three; and the five curved claws (the third and fourth being large) are useful weapons of offence. But they and the fingers are often used for very different purposes, and they have, in the female, to open the curious pouch for the young ones, and to place them there. There is an evident relation between the arrangement of the bones of the wrist and this necessary office or function. The *marsupium*, or pouch, is a kind of inbending of the skin of the lower part of the belly, and is moist and naked inside. In it, in the females, are the nipples of the mammary glands, and to these the very young Kangaroos* hang on for a long time, before they see the outer world. They are put in there by the mother, when they are just born, and when very small and not perfectly formed. They grow there, and after a while, leave the nipple when they think fit. As this pouch, with its contents, would drag upon the mother, it is kept from doing so, more or less, by two bones which are found amongst the muscles of the lower part of the body, and which are attached to the front or pubic bones of the pelvis. They are called marsupial bones. They exist also in the males, but they have no open pouch, for it is, as it were, turned outwards, and contains part of the reproductive organs.



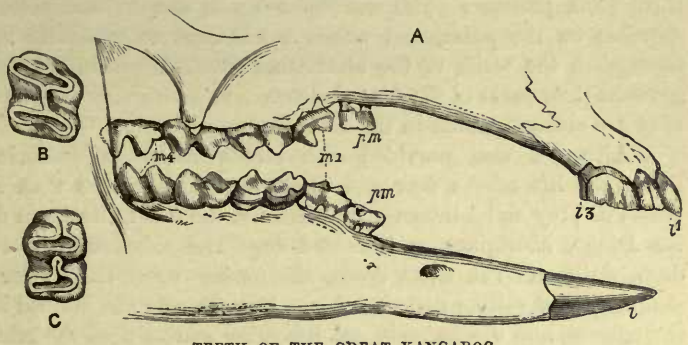
SKELETON OF THE GREAT KANGAROO.

The head is long, and is remarkable for the long nose, and large full eyes, with eyelashes, for the Kangaroo is not nocturnal in its habits, like most of the Marsupials. The upper lip is split, the end of the nose or muffle is naked or hairy according to the kind, and the brain-case is small. The nostrils

* See Footnote (‡) on previous page.

are at the side of the end of the muzzle, and are slit-like and oblique, and there are bristly "smellers" to the fleshy lips and chin. A slender tongue is sometimes seen for an instant whilst the Kangaroo is feeding, and if the bones of the jaws be examined, the angle, or lower part of the back of the lower jaw, will be found to be turned inwards.

The long jaws have not very many teeth, and there are two large lower front ones, or lower incisors, which project in a line with the lower jaw; they are horizontal and more or less pointed, but have an outer and inner cutting edge. The upper incisors, six in number, or three on each side of the middle line, are placed on the pre-maxillary bone, and they work up and down. They are broad and have the cutting edge below, and the outer one, on each side, is broad, grooved, and complicated by one or two folds of its enamel, which are continued from the outer side of the tooth obliquely forward and inward. There is a space or diastema behind the incisors. There are four pre-molars, one on each side of both jaws, and then follow four molar teeth above and below and on both sides of the mouth. The dental formula is thus—Incisors, $\frac{3-3}{1-1}$; premolars, $\frac{1-1}{1-1}$; molars, $\frac{4-4}{4-4} = 28$. There are no canine teeth in the adults, but their germs may be found in the very young Kangaroos. As the Kangaroo is a vegetable feeder, and delights in grass, leaves, and herbs, its teeth are eminently of a non-carnivorous kind. It may be remarked that when the mouth is closed, the cutting edges of the upper incisors come against the outer cutting edge of the long front teeth of the lower jaw. The true molars increase in size from front backwards; and the crown of each molar is squarish, but is longer than broad, and it has two principal cross ridges, which, when not worn, are tall, and have sharp edges. Besides these, there are two other transverse ridges which are smaller and not so tall. One of these is on the front part of the tooth, and the other on the hinder (in the upper molars only). Then there is a long ridge which connects the cross ones. They are all covered with enamel. When the tooth is worn, we find it presenting, according to Mr. Waterhouse,* two powerful loops or folds. On comparing these teeth with those of the herbivorous mammalia already noticed, a remarkable difference will be seen.



TEETH OF THE GREAT KANGAROO.
(A) Upper and Lower Jaw; (B) Upper Molar; (C) Lower Molar.

The hinder extremities consist of a nearly straight, long, cylindrical bone, the femur, which has a hemispherical joint head, and a large trochanter, which reaches above the joint; of two leg bones—the tibia, which is prismatic above and cylindrical below, but with only a slight inner ankle projection, and the fibula, which is distinct but thinned and concave in its lower half, where it is close and attached to the other bone, and forms the outer ankle projection. To these are added the bones of the ankle-joint and the clawed toes. The Kangaroo being a great jumper, and having a great tendon, the analogue of the tendo achillis of man, has a powerful projecting process of the hinder ankle bone for its attachment. But the great length of the foot is produced by the size of the fourth and fifth or two outer toes, and especially of the fourth, which often reaches a foot in length, including the metatarsal bone behind, and the pointed claw in front. The great claw looks like a long hoof, is three-sided and sharp-pointed like a bayonet, and with it the animal stabs and rips open the body of its opponent.† The outer claw is very small, and there is no great toe (or first), but the second and third are long and slender, and are united in a common skin, so as to look like a single toe with a double nail, the hair coming to the roots of it. The long narrow foot is nearly as long as the leg bones, and is admirably adapted for jumping forwards, as well as sideways, and for supporting, when the legs are widely separated, the weight of the erect body. The body in that

* Waterhouse's "Natural History of the Mammalia," order Marsupiata, from which much of this description of the order has been taken.

† R. Owen, "Marsupialia;" "Todd's Cyclopædia of Anatomy and Physiology."

position has the leg bones straight, the thigh bones oblique, and the pelvis and spine erect, the great tail being a prop behind. Owen remarks that in man it is the massive and expanded muscles of the back of the pelvis and upper part of the thigh, or the gluteal muscles,* which are the chief structures in maintaining the erect posture. But in the Kangaroo, the narrow bones of the haunch could not afford attachment to great gluteal muscles; so a muscle which is but slightly formed in man, and is called the little psoas, is greatly developed in the Kangaroo, and has evidently the power of maintaining the erect posture, although it is situate within the body and in front of the spine. The great jumping power is due to the leverage of the ankle and long toes, and the muscles which supply the tendon already mentioned, and others which have the same office. These are of great strength and size, and there are some accessory muscles to the thigh and leg. The long spine of the back has powerful processes, and the jar of the great jumps is received by two vertebræ which, anchylosed or united together, form the sacrum. The tail is made up of many vertebræ, and covered with muscles. The great blood-vessels running underneath it have many chevron, or V-shaped, bones, to protect them from pressure. The marsupial bones, one on each side, are long, and broad below; they are movable on the pubis, and afford attachment to muscular fibres, act as a pulley for others, and strengthen the walls of the abdomen. Formed within muscles and tendons, they are rather bony growths than parts of the true skeleton, and hence they may be absent in some of the order, although they are always present in the Kangaroos.

Although well provided with strong limbs and muscles, and acute senses, the Kangaroos living the life of the deer and cattle of other regions than Australia, are subject to the attacks of beasts of prey and hunters. In Australia the great Carnivora do not exist, but there is a native dog, the Dingo, aborigines, and trained dogs and colonists, who enjoy a Kangaroo hunt. The native dogs stalk and run them down, the natives spear them after sometimes forming a great circle and closing in and yelling and shouting. But the rifle and trained hounds have dislodged many more than the natives, and the animals are becoming scarcer near the settlements than in former years. Dogs which run by sight afford many an exciting hunt, and the Kangaroo starts off, bounding at a great rate, and clearing all sorts of impediments with ease. It is hard riding to keep up with the chase, and especially in hot weather, when the Kangaroo often escapes, thanks to its greater powers of endurance. Sometimes the Kangaroo will stand at bay, and will rip up a solitary Dog with its claws, or will kill with a single blow of the leg and tail. Three or more Dogs are usually laid on, one more fleet than the others, to "pull" the Kangaroo, while the others rush in and kill it. Mr. Gould† says that it sometimes adopts a singular mode of defending itself, by clasping its short, powerful fore limbs round its antagonist, leaping away with it to the nearest water hole, and then keeping it beneath the water until drowned.

Mr. R. Foulerton, who has paid some attention to the habits of the Marsupials, writes that the Great Kangaroo, although its numbers have been greatly diminished in some pastoral districts, still is numerous enough to render some runs almost worthless for pastoral purposes. They may be seen there in thousands, eating off all the best grass, and in the bad seasons reducing the cattle to starving point. They have few enemies but man, as even the native Dog will never attack them, unless they are very young. An "old man" Kangaroo is a formidable opponent; he will severely wound and even kill a man, unless approached cautiously. Their mode of attack is to "hug" him bear fashion, and then rip him with the hind foot. When pursued, they generally take to the water, and there stand at bay, and the luckless man or dog who gets within their grasp is forced under the water, and held there until drowned. The middle-aged Kangaroos, or Flyers, easily outstrip the hunting Dogs at the start, but they are gradually gained upon. When caught, the Kangaroo fights to the last.

The diminutive fore limbs are separated by narrow shoulders, and although the upper arm is short and well furnished with muscles, the fore arm is long, slender, but very movable. The hand is short and broad, and there are four curved, sharp claws, the first one, or thumb, being the smallest, and the third and fourth the largest. The hair covers over the fingers to the claws, which can separate widely, grasp and hold, and be bent on the palm. The movements of the wrists and fore arms are considerable, and a large and long upward-turning muscle is in the space between the ulna

* See also Vol. I., page 58, Note.

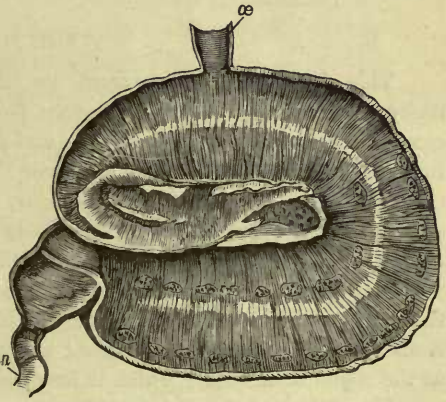
† Mr. Gould's works on Australian animals, occasionally quoted by me.

and radius (the bones of the arm). Moreover, the ulna joints with a cavity in the cuneiform bone of the wrist; and the first row of wrist bones has three in it, and the second has four. The first phalanges, or those of the thumb, are not placed as a thumb in relation to the wrist bones, and it is the outer fingers that grasp with their claws. As the Kangaroo has to lift up its arm, there is a collar-bone, and the arm bone (humerus) is perforated on the inner side of the end above the elbow; and the olecranon is long.

The bladebone has a curved ridge, and the muscles of the upper part are less than those which are attached to the part below it. There are thirteen pairs of ribs to the chest.

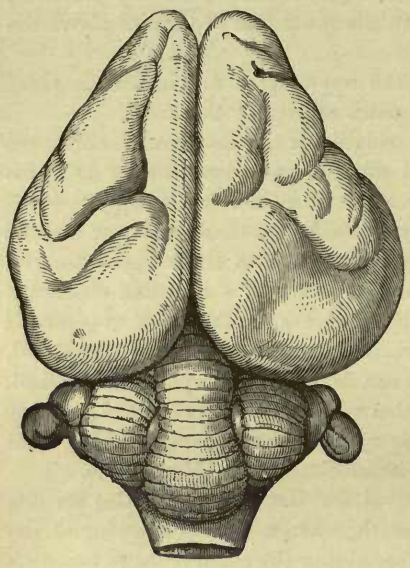
The skull is long and comparatively smooth, and even the ridges for the temporal muscles are only slightly raised; and in old Kangaroos the bones do not unite or anchylose as they do in the other Mammalia hitherto noticed. The teeth are not used as weapons of offence, but simply to graze with, and the lower jaw is not quite solid at the chin, but only so below, so that the lower incisors can be slightly separated. The ear-bone is remarkable for being separated into three parts, namely, the temporal or squamous, the petrosal, and the tympanic; and this is rather a reptilian character. Moreover, the air-chambers of the side of the under part of the skull are in the form of rounded prominences, or "bullæ." They are situated in the lower part of the ear-bone, called squamosal. The zygoma, or process between the cheek (malar) bone and the ear, is hollow, complete, and arched, its front part being, moreover, extended downwards in a projection which reaches below the grinding teeth, and resembles that of the Sloths somewhat. The lower jaw has its back part, or angle, bent inwards (or inflected) strongly, and this is, except in one set, a characteristic of the Marsupiata.

The Kangaroo, being a vegetable feeder, has a stomach suited for the diet, which also permits of a certain amount of regurgitation of food up again into the mouth, when a kind of chewing of the cud occasionally is indulged in. The stomach is large and long, resembling the colon or large intestine of the highest Mammalia in its general shape. It measured, in one instance, according to Owen, no less than three feet six inches, the measurement following its bends or curvatures. It consists of a left, middle, and right or pyloric division. The left ends in two round sacs, and these are really continuations of the stomach separated to a certain extent by a peculiar arrangement of the three bands of muscular fibres which pass separately along the organ. Numerous clusters of secreting glands are found in the mucous membrane of the stomach in its middle part, and they disappear near the pylorus where the tissues are thick and corrugated. The animal has a small intestine, a cæcum, and a large gut, but this last is not much larger than the first part of the stomach. The organs of the circulation of the blood resemble those of the other Mammalia, but there is a distinction which relates to the short period during which the young Kangaroo is a portion of the maternal being. So soon is it born, and so soon therefore must it breathe, that before the heart has grown much, it has the blood from the lungs and the rest of the body running through it. The young Kangaroo breathes when its heart is not fully developed, yet it has the perfect double circulation set up. The auricles of the heart communicate as in other Mammals until birth, but the duration of this communication is very short in the Marsupial, and its traces so evident in the other Mammals are wanting in it. The arteries of the body are simpler than in those Mammals which have a more complicated intestinal arrangement, and Owen, in his great work on the Marsupials, has pointed out that the hind limbs and tail are supplied with arterial blood by vessels which have an arrangement not without its similarity to that of birds. Leading a very simple life, and one of great sameness, moving in a manner which does not require much complexity of muscular action, the nervous system of the Kangaroo could not be expected to be highly organised or fully developed. The brain is small for the body of the animal. It is simple in form, and does not cover the cerebellum, which is visible behind, and has a little lobe on each side. The surface of the brain proper has a few convolutions on it, and more perhaps than



STOMACH OF THE GREAT KANGAROO.
(œ) œsophagus; (*in*) intestine.

the Rodent Mammalia have. The commissures of the brain, which relate to the complexity of the method of life, are unequally developed. The central one, or the corpus callosum, is small, and the front one is very large. Finally, the part of the brain which refers to the sense of smell is large, but hidden by the brain proper, and its nerves supply a large surface in the nose, at its upper part at the base of its skull.



BRAIN OF THE GREAT KANGAROO.

The young Kangaroo, when very small, and almost transparent, comes down from the womb into a canal, and gets into the uro-genital sac, as it is termed. Thence it is taken by the mother, and put into the marsupium, or pouch, where it fixes on to a nipple, and holds on. As the little one is ever "at the breast," it might have any quantity of milk go the wrong way, but this is provided for by the upper part of the organ of voice (the larynx) being prolonged at the back of the nose, above the level of the long nipple. Breathing goes on through the nose, and swallowing safely through the gullet.

THE HARE KANGAROO.*—THE TURATT.

There are many kinds of Kangaroos, and one of them, which is solitary and nocturnal in its habits, is called the Hare Kangaroo, of which Mr. Gould writes:—"The name of Hare Kangaroo has been given to this species as much from its similarity of form and size to the common Hare as from its similarity of habits. I usually found it solitary, and sitting alone on a well-formed seat under the stalk of a tuft of grass on the open plains. For a short distance, its fleetness is beyond that of all others of its group that I have had an opportunity of coursing. Its powers of leaping are also equally extraordinary. While out on the plains in South Australia, I started a Hare Kangaroo before two fleet Dogs. After running to the distance of a quarter of a mile, it suddenly doubled and came back to me, the Dogs following close to its heels. I stood perfectly still, and the animal had arrived within twenty feet before it observed me, when, to my astonishment, instead of branching off to the right or to the left, it bounded clear over my head, and, on descending to the ground, I was able to make a successful shot, by which it was procured. It has the end of the nose covered with a fine set of hairs. The fur is long and soft and very hare-like, and it has small limbs and sharply-pointed nails."

THE GREAT ROCK KANGAROO.

This is very different from its timid congener just described. It inhabits the sterile and rocky mountains in the south-eastern part of Australia. It scampers about the rocks, and readily escapes Dogs, and it is a dangerous and formidable animal to approach, for it will, if closely pressed, turn on its enemy, and force him over the rocks. It bites, and uses its strong fore-arms very efficiently. It is called *Macropus robustus*, and is often found in companies of four or six; and it has more powerful fore-limbs than the Great Kangaroo, which is even sometimes the smaller of the two. It has the part of the nose called the muffle without hair.

THE RED KANGAROO† is so called from the red tint of the male, which is sometimes marked under the neck and elsewhere. It was found in the plains near the Darling and Murrumbidgee rivers, and is celebrated for its great fleetness; and the female is often called the "Flying Doe." It is as fast as the Agile Kangaroo,‡ which is long-haired, and is found in Northern and Eastern Australia.

Van Diemen's Land has a Kangaroo with a long, deep-grey fur, with red on the back of the ears, neck, and shoulders; and it is called the Brush Kangaroo by the settlers. It is eaten and highly esteemed, and its skin is exported for leather. Liking the dense and damp forests of the island, it finds a safe retreat therein, and probably this is what keeps them from extinction, for they have been killed by the thousand, in order to supply contracts for boot-leather. The young of this Kangaroo,

* *Macropus leporoides* (Gould). † *Macropus rufus* (Desm.). ‡ *Macropus agilis* (Gould, sp.).

which is also called after Bennett the naturalist (*Macropus Bennetti*), does not leave the pouch of its mother permanently, until it is as large as a Rabbit.

In the north of Australia, in the region of King George's Sound, there is a small Kangaroo which is not larger than a common Rabbit, and it is a very interesting example of how species may differ from the type of a genus. It has a slender and rather short tail, which is rather scaly, and has but a few hairs on it, but it is not very short. The ears are short and round, and the hind feet are short. The departure from the configuration of the Great and Brush Kangaroo shape is therefore great. It is called the Short-tailed Kangaroo. The last four kinds mentioned are grouped together with others under a sub-genus, *Halmaturus* (ἅλμα, a leap, and οὐρά, a tail).

BRUSH-TAILED ROCK KANGAROO.

THE BRUSH-TAILED ROCK KANGAROO.

Almost as strange as the slender-tailed Kangaroo are those which are called the "brush-tailed," and which inhabit rocky situations (*Macropus penicillatus*). Mr. Waterhouse thus notices them:—

"Whilst the Kangaroos of the plain have the fore part of the body slender and light, great strength in the hinder parts, combined with a long leg and foot, adapting them to fleetness, the tail powerful, and assisting in the support of the long body, we perceive certain modifications in the form and structure of these parts in the Rock Kangaroos which adapt them to their particular habitats. The body, more compact in form, requires but little assistance from the tail for its support, the leverage being less; and the feet are, though powerful, comparatively short, and remarkably rough beneath, being thickly covered over this part with hard tubercles, which no doubt prevent the foot from slipping. The nails of the two larger toes are shorter than usual, and, indeed, in some of the species, scarcely project beyond the fleshy pads with which the toes are terminated, and on the upper surface of which the nails are placed. A long and slender foot, with long nails, as in the typical Kangaroos, it is obvious, would be ill-adapted to an animal which has to leap to and balance itself upon the small ledges of the rocks. The tail is large, but not thickened at the root, as in the plain Kangaroos; and, unlike the tail in those animals, it is clothed with long hairs, which, gradually increasing in length from the base of the tail, become very long and bushy at the opposite extremity. It serves to steady the animal in its leaps, and to balance the body when perched in situations which

require it, but is of little assistance in supporting the weight of the trunk. Its muffle, that is to say, the end of the nose, is naked, as in the scrub-inhabiting Kangaroos just noticed, and it forms the type of the sub-genus *Heteropus*" (ἕτερος, altered, πούς, foot).

One of these was hunted and shot amongst the woods of Liverpool plains, New South Wales, by Sir Edward Parry, who wrote that they appear to be gregarious, and seem to prefer the neighbourhood of rocky ground, in which they had holes, and to which, when hunted, they retreated. They swarm along in groups one after the other, and jump from side to side, alighting on ledges so slightly prominent that their resting thereon appears to be an impossibility. They go into caves and holes in the rocks during the day, and they enjoy the night, and gambol and feed by moonlight.

A Rock Kangaroo, with white and black bands on it, inhabits Western Australia, and a short-eared kind enjoys the hot sands and high rocks of Hanover Bay. There is a Kangaroo in the island of New Guinea (*Macropus Brunii*), and it was the first seen by Europeans.

THE COMMON TREE KANGAROO.*

This is an inhabitant of New Guinea, and instead of frequenting the brush and scrub, which are not physical features found in the island, or the rocks, it lives in the forests, and is no mean but rather a good climber of trees. There is a Kangaroo look about the animal, even when it is seated on a thick branch, but the fur is very different to that of its fellows of Australia. The fur looks coarse and harsh, and is not very unlike that of a Bear. There is no soft under fur, but all the hairs are long and resemble the long ones of the Kangaroos, and the ears are quite clothed with it. Then, as the animal glides down the stem of a tree, the shortness of the hind legs becomes apparent; moreover, the claws on the foot do not resemble those of the Kangaroo. The feet are stout but rather short, and the toes are more equal in size than in the other Kangaroos. The claw of the outer toe is often on a line with the middle of the longest one (the fourth), whilst the nails of the double inner toe extend slightly beyond its base. The nail of this large fourth toe is about an inch in length. Then the fore limbs are nearly as large as the hind ones, and are very strongly made, and so are the hands, the claw of the middle finger being three-quarters of an inch in length. It has a clumsy-looking head, with a high muzzle and small lower jaw. The upper lip is straight. It has a large face and small ears, and the colour of the fur is brown-black and yellow-brown. The tail is very long, tapers slightly, and is considerably of use in steadying the climber, and it is carried very much after the fashion of the other Kangaroos when

COMMON TREE KANGAROO.

* *Dendrolagus ursinus* (Müll.).

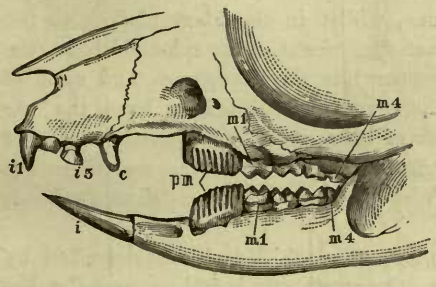
the animal has come down from its tree and hops off to its retreat. A specimen in the Zoological Gardens of London had grizzled-grey fur, whiter underneath the jaws and on the neck and limbs, and the ears were wide apart, and the powerful fore limbs ended in five claws. The tail tapered but very little. This was probably a second species called the Brown Tree Kangaroo (*Dendrolagus inustus*).

These Tree Kangaroos have a small superior canine tooth on each side, and the hinder incisor is not grooved. Hence they form a sub-genus, which is called *Dendrolagus* (δένδρον, a tree, λαγός, a hare), Tree Hare.

KANGAROO-RAT.

THE KANGAROO-RATS.*

These are also called Potoroos, and are of small size, being about that of a Hare or Rabbit. They have a compact body, the neck being short, and the ears are rather rounded, so that their shape is unlike that of the Great Kangaroo, but it resembles that of the smaller kinds somewhat. They have a rat-like shape, both hind feet like the Kangaroos, a long tail, and peculiar teeth. The head is very like that of a Rodent, and the incisor teeth in the upper jaw have the front ones the longest. The canine teeth exist in the upper jaw, and the premolar is large, and has numerous distinct vertical grooves on the outer and inner sides; and the front molars are the largest, the smallest being in the rear. The toes of the fore foot are unevenly developed; the three central ones are large, and those at the side are small. The nails are solid, broadest above, and much compressed. The foot is long, and the fourth toe and nail are greatly developed. The fifth toe is next in size, and the small second and third are coupled together by skin, and form a projection, with two small nails, which are useful in combing and scratching the fur. The first toe is absent. The Rufous Kangaroo-Rat inhabits New South Wales, and is very common.† Its nest is made up of grasses, and is frequently placed under the shelter of a fallen tree, or at the foot of some low shrub. During the day the little animal lies curled up in its nest, but it occasionally reposes in a "seat" like the Hare Kangaroo; but it never sits in the open plains. On being pursued it jumps like a Jerboa, with great swiftness for a short distance, and seeks shelter in hollow logs and holes. Its food consists of roots and grasses. Another is a native of Van Diemen's Land, and keeps to the open, sandy, or stony forest land, rather than to the thick and humid bushes. It is called *Hypsiprymnus cuniculus*.



TEETH OF THE KANGAROO-RAT.

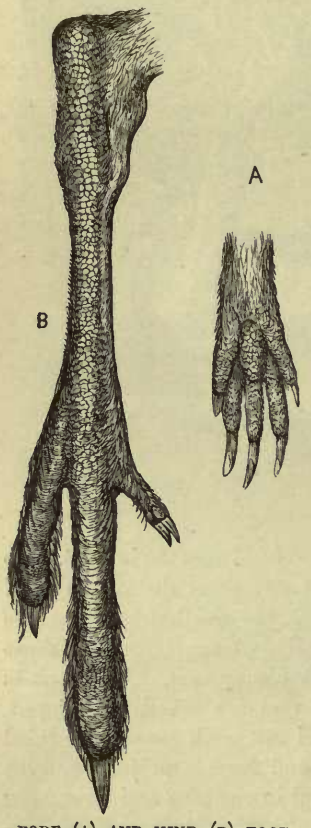
* Sub-genus *Hypsiprymnus*.

† *Hypsiprymnus rufescens*.

None of the animals hitherto described as Kangaroos have any prehensile power in the tail; but in one group of the Kangaroo-Rats, the tip of the tail has a brush of long hairs above, and is clothed beneath with short hairs, which are closely applied to the skin. This structure, and the motion of the muscles beneath, give the Tufted-tailed Kangaroo-Rat* of New South Wales a power of encircling and holding objects, especially for seizing grasses with which to make its nest. This is placed in a hollow in the ground, excavated for its reception, and its opening being on a level with the surrounding herbage, the practised eye of the native is required to discern it. After the little things creep in, they drag some grass after them, and close up the place. In the evening, they sally forth and scratch and dig up roots with their strong fore-claws.

THE RAT-TAILED HYPSIPRYMNUS.†

The Rat-tailed Kangaroo-Rat is about fifteen inches and a half long, and the tail measures, in addition, more than nine inches. It has a long head and rather short hind feet, and the rat-like tail has short stiff hairs on it which do not quite hide the scaly skin beneath. The body fur is long and loose, and dusky brown, more or less tinted with black and pale yellowish-brown. The end of the nose or muzzle is spotted, and the ears are short and rounded. This little animal lives in New South Wales, and was that which was first described by Hunter under the name of Potoroo, or Poto Roo, being the "Bettong" of the natives of New South Wales. The stomach of the Kangaroo-Rats is less sacculated than that of the Kangaroos, but its left-hand portion is enormously developed in proportion to the rest, and may be compared with that of the Ruminantia in point of relative size. It may be noticed that the lower jaws of the Potoroos, which are largely inflected at the angle, articulate with the skull rather differently to those of the Kangaroos. In these last, the cavity at the base of the zygomatic process which receives the lower jaw is broad and slightly convex, permitting considerable side-to-side movement which is useful in the occasional "cud chewing." But in the others the cavity barely deserves the name, it being a nearly flat surface, and, therefore, not much motion, except that of an up-and-down kind, is possible to the jaw. The organ of hearing has been slightly noticed in the Great Kangaroo in a former page, and it is necessary to observe that the tympanic bone does not form a perfect tube in the Potoroos as in the Kangaroos, and that the surface of the auditory cavity is also increased by a "bulla," or bony cavity, bulging out at the under part of the skull. Corresponding "bullæ" were noticed in the Rodentia, but in their case the swelling is in the temporal bone, whilst in the Marsupials, with the exception of the Wombat, they are formed out of the sphenoid bone (the great ala). Moreover, the Potoroos, like the Kangaroos, and some of the other Marsupials (the Phalangers and Koalas), have the ear chamber prolonged, by a number of cells, into the zygomatic process of the temporal bone. The Kangaroo-Rats are numerous, and there are many species. They are distributed in New South Wales, Western Australia, Van Diemen's Land, and South Australia, and to the north-east.



FORE (A) AND HIND (B) FOOT OF HYPSIPRYMNUS.

Sir R. Owen investigated the anatomy of a small Kangaroo-Rat which had been described by Mr. Ramsay in Australia, and which was remarkable for its musky smell. It is a long and slender-bodied little animal, measuring about one foot three inches and a half from the snout to the end of the tail, which is five inches and nine lines in the female, and rather less in the male. Its hinder legs are shorter, and the head is more slender and pointed than in the Kangaroo-Rats just described. The fur is of moderate length, pretty closely applied, and has numerous rather long hairs scattered here

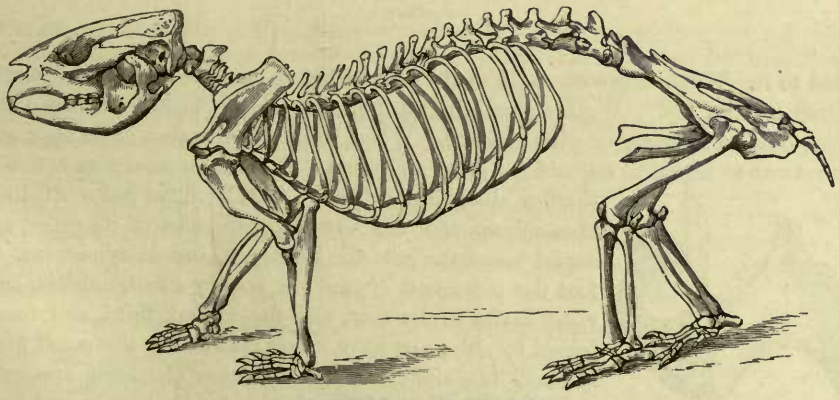
* *Hypsiprymnus penicillatus.* † *Hypsiprymnus murinus.*

and there, the visible portions being black or blackish, or pointed. These are relieved by the dark and light-barred colour of the visible part of the shorter hairs, all the hairs being of a leaden-greyish tint at the skin. The upper surface of the body has a close and stiff fur of rich golden colour, mixed with black; the head, face, and lower parts of the legs are dark brownish-grey; and there are a few patches of white along the centre of the throat and chest. The fur covers the tail for half an inch or more, and then the rest is naked, and covered with a network of scales about three to a line in length. The scales are black above, and a few minute and very short hairs project from the interstices of the scales. The animal has a naked muffle and rounded ears. The hind foot is remarkable, for whilst the skull and dentition of the creature would associate it more with the Kangaroo-Rats, the position of the first toe (wanting in the Kangaroo-Rats) resembles somewhat that of the Phalangista group, or the Phalangers, which will be noticed further on. The sole of the foot is long, and there is a nailless projecting first toe, like a thumb; next come the second and third toes—small, united by skin, and leaving the two combing-nails visible; and then the largest, or fourth toe, is followed by a smaller fifth. Sir R. Owen judged that this animal was an occasional climber of trees, but that its usual locality was on the ground. Mr. Ramsay states that it lives in the Rockingham Bay district, and that it frequents the dense and damp positions of the scrubs which fringe the rivers and clothe the sides of the coast range. Its habits are diurnal, and its movements are graceful. It procures its food by turning over the rubbish in search of insects, worms, and tuberous roots, frequently eating the palm-berries, which it holds with its fore paws, after the manner of the Phalangers, sitting up on its haunches, or sometimes digging. They have a pouch, and two young ones have been found in it. Considering the importance of the great toe to the animal, and its linking together the climbing and jumping Marsupials, Sir R. Owen acknowledged the necessity of recognising Mr. Ramsay's name of *Hypsiprymnodon moschatus*, and of thus bringing in a new genus into a new family in the Kangaroo series with two large front teeth in the lower jaw.*

II.—THE WOMBAT FAMILY.—THE PHASCOLOMYIDÆ.

THE WOMBAT.†

On looking at a picture of a Wombat, the outside distinctions between it and all the Kangaroo family may be seen at a glance, and an examination of its anatomy affords still greater evidence of differences which, to a certain extent, relate to the fact that the animal now under consideration is a burrower and gnawer. About two to three feet in length, the Wombat has only a small stump of a



SKELETON OF THE WOMBAT.

tail, a low body, small feet, and strong limbs, ending in broad extremities, well provided with claws. It has moderately long and coarse fur of a grey-brown colour, and there is some white about the short ears, and the feet are black. It is usually a plump animal, with a bare black muzzle, and feet naked beneath, and covered with little tubercles of flesh. The claws are large, and those of the fore feet (five

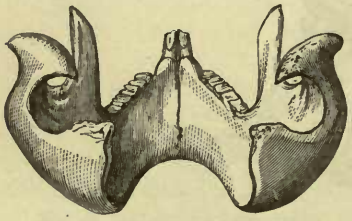
* Description by E. P. Ramsay, F.L.S., and communication from Sir R. Owen to Linnean Society, London.

† *Phascolomys Wombat* (Peron and Lesson). φάσκωλος, a pouch, and μῦς, a mouse.

in number) are solid and but little curved, whilst the four on the hind feet are curved and concave beneath. It has long moustache hairs, and plenty of them. Sir Everard Home had one, and he found that its principal desire was to get into the ground, and to do this it worked with great skill and rapidity, covering itself with earth with surprising quickness. It was very quiet during the day, but was in constant motion during the night; was very sensible of cold; ate all vegetables, and was particularly fond of new hay, which it ate stalk by stalk, taking it into its mouth like a Bear, in small bits at a time. It was not wanting in intelligence, and appeared attached to those to whom it was accustomed, and

WOMBAT.

who were kind to it. When it saw them, it would put up its fore-paws on their knees, and when taken up would sleep on the lap. It allowed children to pull and carry it about, and when it bit them it did not appear to do so in anger or with violence. When wild, the Wombat hides up during the day, and quits its retreat at night, to dig and get grass and roots. It is by no means an active animal, and shuffles along like a Bear. The Wombat has a slit-like, imperfect marsupium, and the special peculiarities of its order, such as marsupial bones, the inflected lower jaw, and double uterus. On the hind foot the innermost or first toe is very small, nailless, and placed at right angles to the foot, and the second, third, and fourth toes are joined by skin, and have larger claws than the small fifth toe. The stomach is simple, and has a peculiar glandular apparatus, and the cæcum is short, and has an appendage as in man and some monkeys.

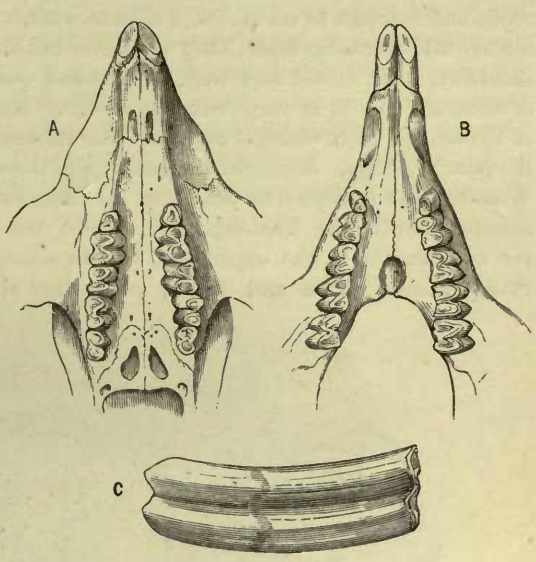


LOWER JAW OF THE WOMBAT.

The teeth are remarkable for their number in relation to those of the Kangaroos, and for having no rootlets. The incisor teeth greatly resemble those of a Rodent, like the Rat. They are two in number in each jaw, and are widely separated from the other teeth. The molars are long, curved, and, like the incisors, have no true fangs, but persistent pulps. They are divided into two nearly equal parts by a fold of the enamel entering deeply into the body of the tooth on one side, and a slight indentation on the opposite side.

The number of the persistent teeth is as follows :—Incisors, $\frac{2}{2}$; true molars, $\frac{4-4}{4-4}$. It is the only

Marsupial which has an equal number of incisors in both jaws. There are no canines. As the Wombat uses much force in gnawing, the muscles of the jaws and their bony attachments are large; consequently the temporal ridges are strongly marked. There is a deep and strong zygomatic arch, and in the lower jaw the turned-in angle is of great size. The chin is also large, and the joint of the jaw also. The sutures of the bones of the skull are scarcely ever obliterated, and the auditory "bullæ" are formed in the temporal bone. With regard to the marsupial bones, they are long, flat, curved, and, moreover, less expanded near their attachment to the pubis. The ribs are fifteen in number on each side, and the collar-bones are large and stout. There is a curious power of movement of the ankle, so that the foot can imitate the turning movements of the wrist and fore-arm of man. This pronation and supination is because the small bone of the leg, the fibula, is free and not attached to the other bone (tibia), and because there is a muscle whose action is to move the fibula after the fashion of the corresponding muscle in the fore limb. The stomach is smaller than in the Kangaroos, and has a large gland.



TEETH OF THE WOMBAT.
A, Upper Jaw; B, Lower Jaw; C, Molar.

The Wombat has been found in South Australia, Van Diemen's Land, Bass Strait, and in New South Wales.

CHAPTER II.

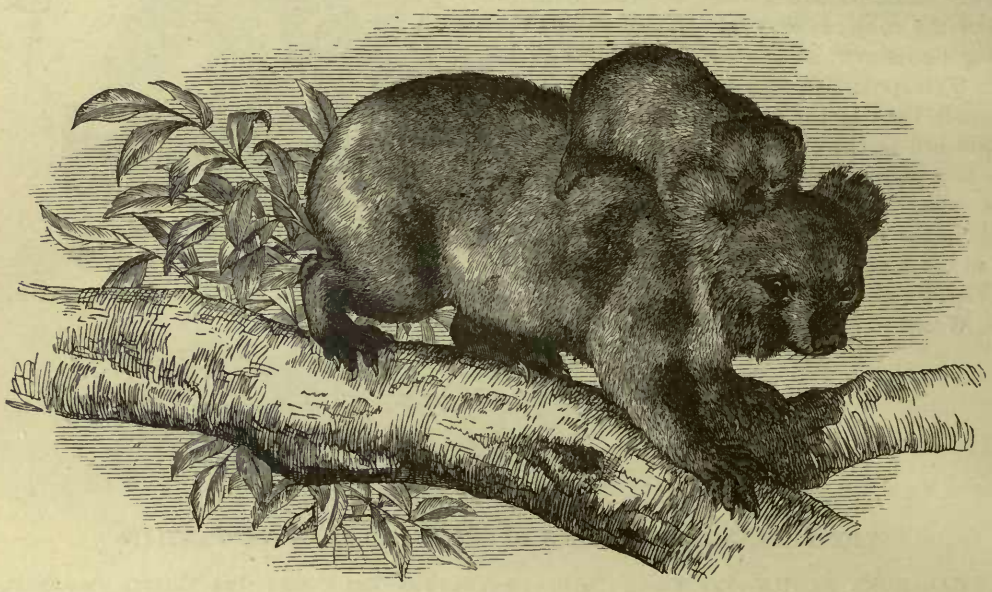
THE PHALANGER, POUCHED BADGER, AND DASYURE FAMILIES.

THE PHALANGER FAMILY—THE KOALA—Habits—Characteristics—THE CUSCUS—THE VULPINE PHALANGER—THE DORMOUSE PHALANGER—Habits—Remarkable Characters—THE FLYING PHALANGERS—Its Flying Machine—Habits—THE SQUIRREL FLYING PHALANGERS—Habits—The Parachute-like Membrane—Exciting Scene on board a Vessel—Characteristics—THE OPOSSUM MOUSE—THE NOOLBENGER, OR TAIT—A Curiosity among Marsupials—Distinctive Features—THE POUCHED BADGER FAMILY—Characteristics—THE RABBIT-EARED PERAMELES—THE BANDICOOT—THE BANDED PERAMELES—THE PIG-FOOTED PERAMELES—Discussion regarding it—Characteristics—THE DASYURUS FAMILY—Characteristics—THE POUCHED ANT-EATERS—THE BANDED MYRMECOBIUS—Description—Great number of Teeth—History—Food—Habits—Range—THE URSINE DASYURE—Appearance—"Native Devil"—Ferocity—Havoc among the Sheep of the Settlers—Trap to Catch them—Its Teeth—A True Marsupial, though strikingly like the Carnivora—Skeletal Characters peculiar to itself—MAUGE'S DASYURE—THE DOG-HEADED THYLACINUS—Description—Resemblance to the Dog—Habits—Peculiarities—THE BRUSH-TAILED PHASCOGALE—Description—Other Varieties.

III.—THE PHALANGER FAMILY.—THE PHALANGISTIDÆ.

THE loftiest of the gum-trees of the country from Moreton Bay to Port Phillip, and even more widely than this, were often the familiar haunt of a small Marsupial animal, not unlike a little Bear, about two feet in length, and without a tail. It is a famous tree-climber, and its stout body, small head, short limbs, and well-developed feet, are all cased in an ash-grey fur. It has moderate-sized ears, which are hidden by the long hair of the head, and it has a short and nearly naked black muzzle. The eye is large and without eyelashes. The natives climb up the trees after it, according to Mr. Gould, with as much ease and expertness as an European would get up a long ladder, and having reached the branch, perhaps forty or fifty feet from the ground, they follow the animal to the extremity of a bough, and either kill it or take it alive. This animal is called the KOALA, and it feeds

on the tender shoots of the blue gum in preference to those of any others, and it rests and feeds in the boughs. At night it descends and prowls about, scratching up the ground in search of some peculiar roots, and it seems to creep rather than to walk. When angry it utters a long, shrill yell, and assumes a fierce and menacing look. They are found in pairs, and the young soon learn to perch on the mother's shoulders. Mr. Gould says that, unlike most quadrupeds, the Koala does not flee upon the approach of man, and that it is very tenacious of life. Even when severely wounded it will not quit its hold of the branch upon which it may be. The animal has a nice thick fur, which nearly hides the ears, and the pouch is large. A careful examination of the animal shows that it differs from the Kangaroos and Wombats; it is more like the latter than the former, but it is sufficiently distinct to be placed in another family, the Phalangers, in which the incisors are six above and two below, and there are two canines in the upper jaw, and in some, two in the lower jaw, but not in all. There are two premolars above and below, and either six or eight molars in the upper and lower jaws.



KOALA.

The head is rather small, and the face is short, the upper lip being cleft. The limbs are equal; the fore feet have five well-made toes with compressed and curved claws; the hind feet have five toes, of which the first or inner one is large, nailless, and at right angles to the rest, and opposable to them. The second and third toes are shorter than the others, and are united in a common skin, and they have nails. The fourth and fifth toes are curved and have compressed claws. The name Phalangista is derived from this union by skin of the phalanges of the foot. The tail may be absent, or long, and more or less prehensile, but sometimes not.

There is a well-developed pouch, and the stomach is simple, and the cæcum is usually very long and large. One young one is produced at a birth.

The Koala, or Native Bear,* may be taken as the type of the tailless group, and it belongs to the genus *Phascolarctus*.

The Cuscus, or Ursine Phalanger,† belongs to a second division, for it has a prehensile tail. They are common animals in the dense woods of the Island of Celebes. They squat on the branches half asleep by day, but are lively enough at night, and it is said that they have a fancy for flesh as well as fruit. A pretty spotted Cuscus inhabits the islands of Amboyna, Waigeoe, Banda, and New Guinea, as well as Cape York.‡ They are dull in captivity, but when placed together they fight with fury, growling

* *Phascolarctus* (pouched-bear) *cinereus.* † *Phalangista ursina.* ‡ *Phalangista* (*Cuscus*) *maculatus.*

like Cats, and biting. They have small red eyes with a vertical pupil, short ears, and a very stupid look. They are all nocturnal in their habits, and feed on fruit, buds, leaves, meat, and eggs.

One of the Phalangers, called *Cuscus albus*, is abundant in New Ireland, Amboyna, Banda, and Timor, and is remarkable for its peculiar odour. The male is white, and the female reddish-brown in colour, both being about the size of a common Rabbit. It is slow in its movements, lives in trees, and takes good care to conceal itself, but its scent discovers it. The naturalists Lesson and Garnet stated that when they traversed the forests of the island the odour of the Cuscus was distinctly perceptible. It is stated that if these animals see any one, they suspend themselves at once by the tail, and if they are looked at steadfastly, they will drop by-and-by from fatigue, and are then easily caught; in fact, they pretend to be dead.

CUSCUS.

THE VULPINE PHALANGER.*—THE BRUSH-TAILED "OPOSSUM."

Waterhouse describes this Marsupial to be about the size of a Cat, but in shape it is somewhat between a Squirrel and a Marten. It has long and somewhat pointed ears; and the tail, clothed with bushy, harsh, black fur, except beneath, near the end, where it is naked, is about as long as the body. The limbs are rather short, the muzzle is moderately long and foxy-looking, and the whole body and head, except the naked muzzle, are covered with a grey and black fur. The moustaches are long, numerous, and black, and the feet are yellowish-white, and the naked soles are flesh-coloured, the nails being dusky. The pupil of the eye is round and intensely dark in colour. They sleep during the day, and become active during the evening, and on the alert for their food, which consists, in the Zoological Gardens, of bread and milk, fruit and vegetables. They hold up the solid food between the hands as a Squirrel holds a nut, and nibble very much in the same manner. Their native haunts are New South Wales, Western Australia, and North Australia. They inhabit the large trees, usually the Eucalypti, selecting such as have the heart of the branches or trunk decayed, and they take refuge there during the daylight. At night they leave their nests and climb the branches of the trees which yield them buds and fruit. They descend to the ground for food, and doubtless now and then eat snails and small birds. When climbing they use the tail to hold by, and carefully grasp every support with it before they let go with their feet or hands. A brown-black species, closely allied, lives in Van Diemen's Land.†

* *Phalangista vulpina.* † *Phalangista fuliginosa.*

VULPINE PHALANGER.

THE DORMOUSE PHALANGER.*

This is a very small Marsupial animal, about six inches in length, including the tail, which measures nearly, if not quite, one-half. It is like a little Dormouse, with its soft fur, ashy-grey in colour, large ears, and thick tail. They are broader, not so long in the leg, and usually larger than the Dormouse, and the eyes are larger, and the upper jaw overhangs the lower. But they look just as fat and sleepy in the daytime. The habits of these animals, moreover, are much the same, for the Phalangista living in Van Diemen's Land feeds on nuts and other similar food, which they hold in their fore paws, using them as hands. They are nocturnal, remaining asleep during the whole day, or, if disturbed, are not easily roused into a state of activity. They come forth in the evening, and are then more easy and rapid in their movements. Some of these were kept in the Zoological Gardens of London, and it was noticed that they made great use of their tail, which is prehensile, and thus not like that of the Dormouse. They ran about a small tree, using their paws and tail to hang on by, and using the tail as a suspender when they descended. Sometimes the tail is thrown in a reverse direction, and is turned over the back, and at other times, when the weather is cold, it is rolled closely up towards the under part, and coiled up almost between the thighs. They are like little balls of fur, and are very gentle and harmless.

Mr. Gould states that another kind of these Dormouse-looking creatures is very abundant in the northern portion of Van Diemen's Land, and that of all trees it appears to prefer the Banksia, whose numerous blossoms supply it with a never-ceasing store of food, both of insects and sweets. It undergoes a kind of hibernation somewhat similar to but not to the extent of that of the Dormouse.

These pretty little marsupials are remarkable by having only three true molar teeth in each jaw on both sides; but they have the usual two narrow, long, and pointed incisors in the lower jaw. The auditory bullæ on the base of the skull are large, and the hard palate has four openings in it. The lower jaw is slender behind, and the angular process is inflected, the process of bone being, however, slender and pointed. Their mouse-like shape is evident, but they have a large eye, and the ears are often more or less crumpled and pendent, but they start up and are erect at the least noise. There are three species of these Phalangistidæ, and they are included in a sub-genus, Dromicia. They live in Van Diemen's Land, Western Australia, and South Australia. Some which were found in King George's Sound district live in retreats under the dead bark of trees, and in holes in trees which have been burnt out.

* *Phalangista Nana.*

THE FLYING PHALANGERS.

The next genus of the family Phalangistidæ contains the Flying Phalangers, which form the genus Petaurus. They have all the peculiarities of the Phalangers, and also a skin on the flank of the body, which is extended between the fore and hind legs, which serves to sustain the animal in the air, when descending from a height. They have a long hairy tail. The Yellow-bellied Flying Phalanger (*Petaurus australis*, Shaw) may be taken as the type of the genus, and is fourteen inches long in the body, and nineteen in the tail. The peculiar fold of fur, which is its flying machine, is attached to the fore leg as far as the elbow, and all down the legs to the great toe. It is common in all the brushes of New South Wales, particularly those along the coast from Port Phillip to Moreton Bay. Mr. Gould states, in addition to this, "In these vast forests, trees of one kind or other are perpetually flowering, and thus offer a never-failing supply of blossoms, upon which the animal feeds. The flowers of the gum-trees, some of which are of great magnitude, are the principal favourites, and, like the rest of the genus, it is nocturnal in its habits, dwelling in holes of trees and in the hollows of branches during the day, and displaying the greatest activity at night, while running over the small leafy branches, sometimes even to their very extremities, in search of insects and the honey of the newly-opened blossoms. Its structure being ill-adapted for terrestrial habits, it seldom descends to the ground, except for the purpose of passing to a tree too distant to be attained by springing from the one it wishes to leave. The tops of the trees are traversed at a pace and with as much ease as if it were on the ground. If chased, it ascends to the highest branches, and performs enormous leaps, sweeping from tree to tree with wonderful address."

A slight elevation gives its body an impetus, which, with the expansion of its membrane, enables it to pass to a considerable distance, always ascending a little at the extremity of the leap. By this ascent the animal is prevented from receiving the shock which it would otherwise sustain.

THE SQUIRREL FLYING PHALANGER.*

This little creature, called the Sugar Squirrel by the colonists, is very generally dispersed over the whole of New South Wales, where, in common with other Phalangers, it inhabits the magnificent gum-trees. Mr. Gould states that it is nocturnal in its habits, and that it conceals itself during the day in the hollows of trees, where it early falls a prey to the natives, who capture it both for the sake of its flesh and skin, which latter, in some parts of the colony, they dispose of to the colonists, who occasionally apply it to the same purposes as those to which the fur of the Chinchilla and other animals is applied in Europe. At night it becomes extremely active in its motions. It prefers those forests which adorn the more open and grassy portions of the country rather than the thick brush near the coast. By expanding the membrane attached to the sides of its body it has the power of performing enormous leaps. They have the power of changing their course to a certain extent when descending, parachute-like, from a height. It is stated that a ship sailing off the coast had a Squirrel Petaurus on board which was permitted to roam at large. On one occasion it reached the mast-head, and as the sailor who was sent to bring it down approached, it made a spring from aloft to avoid him. At this moment the ship gave a lurch, which, if the original direction of the little creature's course had been continued, must have plunged it in the sea. All who witnessed the scene were in pain for its safety; but it suddenly appeared to check itself, and so to modify its career that it alighted safely on deck. This kind is not more than eight or nine inches in length, and its bushy tail is as long as the body. The soft fur of the tail, like that of the body, is a delicate ashy-grey. There is a long stripe of black fur from the naked tip of the nose to the root of the tail, and the cheeks are white with a black patch; the flank membrane is edged with white, and this is the colour of the underneath part of the body; the ears are long, and of a brownish flesh colour.

Another kind, with a yellow flank membrane, is short-headed, and it inhabits Port Essington, North Australia,† whilst the true Short-headed Flying Phalanger is found in New South Wales.‡ Probably it is the first of these which is found in New Guinea, and which has been called the Squirrel Flying Phalanger by mistake. These Flying Phalangers all have long and nearly naked ears,

* *Petaurus sciureus* (Shaw). † *Petaurus ariel.* ‡ *Petaurus breviceps.*

SQUIRREL FLYING PHALANGER.

and the side membrane extends to the outer finger. They have the outer two fingers of the hand long and equal to each other, or very nearly so; the second and third fingers are distinctly shorter than these; and the inner finger is very short. Their dentition is—Incisors, $\frac{6}{2}$; canines, $\frac{1-1}{0-0}$; premolars, $\frac{3-3}{4-4}$; true molars, $\frac{4-4}{4-4} = 40$. The incisors of the lower jaw are, as usual, long and pointed, and almost horizontal, whilst the upper incisors are large and dilated, so far as the anterior ones are concerned, and the next is smaller than the hindmost. The canine is large, and separated from the first premolar, which is large and compressed, and all the molars have rounded tubercles on them.

The Opossum Mouse * of the colonists of New South Wales used to be common in the neighbourhood of Port Jackson. It is about the size of a common Mouse, and of an ashy brown and grey colour on the upper parts and on the flank membrane; the rest is white. It belongs to the Flying Phalangers, but its side membrane scarcely extends to the wrist, and the thumb of the hind foot is large. It has only three true molars in each jaw on both sides, and the canine is close to the incisors. It forms part of the sub-genus Acrobata, whilst those already mentioned constitute the sub-genus Belideus (βέλος, a dart). Finally, the short-eared, white-bellied Taguan Phalanger of the scrub of New South Wales is the type of the sub-genus *Petaurus*.

GENUS TARSIPES.—THE NOOLBENGER, OR TAIT.†

This is an Australian curiosity amongst the Marsupials, and is a small, mouse-like thing, with a long muzzle, small ears, long tongue, and very few teeth. Its dental formula is—Incisors, $\frac{2-2}{2}$; canines, $\frac{1-1}{0-0}$; molars, $\frac{3-3}{3-3}$. The fore and hind extremities have toes something like those of the Lemur, called Tarsius (Vol. I., page 248). The fore feet have five smallish toes, each thickened at the end, and a minute scale-like nail, which reaches neither the end nor sides of the toe. The hind feet have five toes on each, and the innermost has the formation of a thumb, and is slender and nailless. The second and third toes are very short, and are joined to the end and furnished with small pointed nails, which are directed upwards almost at right angles to the plane of the toe; and the fourth toe is twice as long as the second and third. The fifth is shorter than the fourth, and

* *Petaurus pygmæus.* † *Tarsipes rostratus.*

has a scale-like nail on the upper surface. This is the case with the fourth also. There is a long, slender tail. The small bones of this little honey-sucker are very thin, and the lower jaw has two slender and almost straight sides, and the inflection is wanting.

This little animal is rare, but it is to be found in West Australia, from Swan River to King George's Sound. It is nocturnal in its habits, and catches flies in captivity with great ease. But its food is honey, which it gets like a moth, with its tongue. The tail is prehensile, and the little pouch contains four mammæ in the female.

The little Tarsipes, with its honey and insect diet, has a very long intestine and no cæcum, whilst the Koala has a cæcum more than three times the length of its body. The pigmy Acrobata has this organ disposed in a spiral curve in the left lumbar region. The marsupial bones are large in the Koala, and are long, broad, and flat, almost equalling the iliac bone in size. Finally, with regard to the parachute-fold of skin on the flanks of the Petaurists, it is a simple fold with very elastic tissues within, which draw it up to the body, more or less, when the animal is walking or standing. When, however, the limbs are extended after a jump, the membrane becomes very tense, and acts by increasing the surface of the body so as to oppose gravitation by the supporting power of the air.

IV.—FAMILY PERAMELIDÆ.—POUCHED BADGERS.

This group of Marsupials embraces two genera, Perameles and Chœropus, the first having several species and the last but one. They have all long, slender heads; large, long ears, with fleshy lobes; longer hind than fore limbs; the tail short in some, long in others, and hairy; and the pouch is directed backwards. They have a considerable number of teeth, there being ten incisors in the upper jaw and six in the lower; there are two canines in each jaw, three premolars in each jaw on either side, and four true molars behind them, making forty-eight teeth in all. The teeth have fangs, the premolars are compressed and pointed, and the molars have tubercles on them. The stomach is simple.

GENUS PERAMELES (BANDICOOTS).—THE RABBIT-EARED PERAMELES.*

The so-called native Rabbit of the Swan River district of Western Australia is abundant in the grassy country in the interior; and it frequents, in pairs, places where the soil will permit of burrowing. It is about the size of a common Rabbit, and has a long and pointed muzzle, which is naked at the tip. It has long, oval ears, which are tubular at the base. The eye is small, and the tail is a little shorter than the body. The legs are longish, and the fur is well grown.

This sharp-looking animal lives upon insects, and its favourite food is a large grub, probably the larvæ of a species of Buprestis beetle which infest the roots of the acacia trees. In order to obtain this peculiar food, it has to compete with the natives, who like it also, and often enough it has to rush to its long and deep burrows for safety. Its flesh is sweet, and is much sought after by the aborigines. One which was kept at the Zoological Gardens was very active in the evening, but usually slept during the day-time, when, sitting upon its haunches, with its head thrust between its hind legs, it appeared like a ball of fur. It was a very savage animal, and bit severely, holding on, moreover, if it could, with its teeth. It waddled on its hind legs alone, which were straddled, and the tail assisted in supporting the body. They have five toes to the fore-foot, of which the two outermost are rudimentary and nailless, the remaining three are well developed, and are furnished with strong solid nails, which cover the last phalanges which are cleft above in the longitudinal direction almost to the root. The hind feet have a rudimentary inner toe, the second and third are joined and are slender, and have two hollow nails, and the fourth is large and, like the fifth, which is well developed, has a solid nail sheathed on the end bone.

GUNN'S PERAMELES.—THE BANDICOOT.†

This is the animal which has given the native name to the genus, and Mr. Gunn, who discovered the species, informed Mr. Waterhouse that it is common in many parts of Van Diemen's Land, going by the name of Bandicoot. It is a burrower, and lives principally upon roots, and it likes the bulbs

* *Perameles lagotis.* † *Perameles Gunnii.*

which are introduced from the Cape and elsewhere into gardens. It is about sixteen inches long, and has a slender muzzle, moderate-sized ears, and the under parts of the body are white, the rest being grey and pencilled with black and yellow, except behind, where it is blacker. There are four broadish white bands on this part.

THE BANDED PERAMELES.*

This is a pretty little Perameles with a body about a foot in length, and a tail of about four inches long. It has rather a sharp and long snout, rather large ears, which are broad at the base, and long and pointed at the tip. The fur is longish and harsh, and is pencilled with black and yellow in about equal proportions on the upper part of the body, there being a black ground colour on the hinder part of the back. There, however, there are three broad yellow-white bands, the foremost of which crosses the back. The feet and under parts are white, and the tail is of the same colour underneath, but

BANDED PERAMELES.

black on the top. The feet are slender, and the hind ones have a rudimentary inner toe, naked beneath, in front, and at the heel. In the skeleton this inner toe has one or two phalanges, and a small tubercle without a nail is visible before the flesh is removed. It inhabits Southern Australia from east to west. This kind resembles the Bandicoot of Van Diemen's Land on the other side of Bass Strait, and may be considered its representative. It is smaller than the Van Diemen's Land species, but its tail is longer; moreover, the ear exceeds those of the insular forms in size. Like the other Perameles, the pouch for the young opens backwards. "Though provided with strong claws it rarely burrows," says Mr. Krefft, "and it is a great enemy to little Rodents. It tumbles the Mice about with its fore paws, breaks their hind legs, and eats the head."

New Guinea contains a short-legged Perameles,† which appears to be deficient in the usual number of upper incisor teeth; and another ‡ resembling the common Bandicoot.

GENUS CHŒROPUS.—THE PIG-FOOTED PERAMELES.§

A very rare little, large-eared, small-legged animal was found by Sir Thomas Mitchell on the banks of the River Murray, and its appearance was so remarkable that much attention was paid to its

* *Perameles fasciata.* † *Perameles doreyanus.* ‡ *Perameles moresbyensis* (Rams.).
§ *Chœropus castanotis*—χοῖρος, a hog; and πούς, a foot.

anatomy, whilst unfortunately nothing particular was learned regarding its natural history and habits. Subsequently the little creature, whose body is about nine inches and a half long, the tail measuring in addition about four inches, was found in the interior of the country near the Swan River. It is an active little animal, and a hunter of insects, but it will feed upon vegetable substances also. Mr. Gould states that, like the Perameles, to which it is allied in many parts of its construction, it forms a nest composed of leaves and other substances. The pouch is deep and runs upwards, and not like that of the Kangaroo, and there are eight teats. At first there was much discussion whether the animal had a tail, but there is no doubt about its possessing one when in the perfect condition. The slender fore limbs, no thicker than goose-quills, end in two very small digits, and they are provided with small, compressed, and but little curved nails. They have a small fleshy pad on their under surface, behind which is a smaller one. The hind legs are longer than the front ones, and are almost as slender. The foot is long, and at first sight appears to have only one large toe, for the others are very small and far removed from the end of the foot. The outer little toe has a small nail, and the inner toes, joined, are almost as small, but they have hollow nails. The greatly-developed toe has a conical and compressed nail, but beneath there is a large fleshy pad; the rest of the foot is hairy. Hence it appears that the heel is not put to the ground. The colour of the long, loose, soft fur is brown-grey above, and yellowish-white beneath, the limbs and the fore feet have a whitish tint, and the large toe is of a dirty white colour. So far as the skull and teeth are concerned, the little Chœropus greatly resembles the other kinds of Marsupials which are classified under the genus Perameles. Sir Thomas Mitchell noticed the broad head and very slender snout, which, he stated, resembled the narrow neck of a wide bottle, in the specimen which the natives took from a hollow tree after chasing it on the ground. In the construction of the skull and in the number of the teeth, this long-eared creature resembles the rest of the genus Perameles. In the upper jaw there are five incisor teeth on each side, and they are close, and the canine is small, and resembles a premolar, and is slightly distant from the incisors. The first premolar is separated from the canine by a space of one line and a half, and slightly from the second premolar; and the second and third premolars and the four molars form a continuous line.

V.—THE DASYURUS FAMILY.—DASYURIDÆ.

These animals are all carnivorous, and prey upon small quadrupeds and the young of large ones, as well as upon birds and insects. They are of different shapes and sizes, according to the genera to which they may belong; and whilst some resemble the Shrew Mice somewhat in outward appearance, others are like the Marten, and one important group may be compared with Short-legged Wolves, or Jackals. Varying in size from that of a Mouse to a small Wolf, the members of the different genera of this family are equally variable in the number of the teeth, of the claws, and in the development of the marsupial pouch and its bones. They all have rather long muzzles and furry tails, which, however, are not prehensile. The second and third toes of the hind feet are disunited and well developed, and the thumb-toe is small or absent. There are eight incisors in the upper jaw, and six in the lower.

GENUS MYRMECOBIUS.—THE POUCHED ANT-EATERS.*

The Banded Myrmecobius may be taken as an example of this genus. It is about the size of a Rat, but it is more Squirrel-like in shape, and has a long and pointed muzzle. The tail is long and furry, with long hairs also; and the prevailing colour of the body is reddish, but posteriorly it becomes dark or black. There are nine bands of light or white colour on the sides of the body, from the back over the flanks, and the crupper is also marked with a band. The head is long, the ears are moderately long, narrow, and pointed, the gape is considerable, and the small pointed snout has some rather long smellers; there are also some long hairs under the eye. A black mark runs on the cheek to the ear, and has white hairs above and below it. The fur is somewhat remarkable. The under hair is scanty and whitish-grey, and the upper hair is rather coarse, short, and depressed on the fore parts of the body. It is long on the hind and under parts, and the hairs on the fore part of the back are black near the skin and reddish at the tip. The fur of the head is short and brownish above, being composed of

* *Myrmecobius fasciatus*—μύρμηξ, ant; βιος, life.

a mixture of black, fulvous, and a few white hairs. The fore legs are rather stout and strongly made, and the five curved and compressed claws are admirably adapted for its method of life, which consists of insect-hunting by digging. The hind limbs are suited to support the weight of the animal, as it scratches with the fore feet, but they are deficient in the first toes. The whole animal is about seventeen inches long, seven inches being included in the tail. This animal has a greater number of teeth than any other Marsupial, and, indeed, they are only surpassed by some Cetacea and Edentate Ant-eaters amongst the other Mammalia. There are fifty-two teeth in the mouth—namely, eight upper and six lower incisors, four canines, six compressed false molars behind the canines above and below, and ten small true molars above, and twelve below. The canines of the lower jaw are incurved, and the last lower molars are worn in ridges internally. The number of teeth appears, however, to be variable, and some have fifty-four and others less than fifty.

The Myrmecobius, although it has the inflected condition of the lower jawbone and small marsupial bones, not more than half an inch in length, has no pouch. The young adhere to the mother's nipples, and are protected by the comfortable fur and long hair of her body.

The Banded Myrmecobius was first discovered by Lieutenant Dale, who procured a specimen whilst on an exploring expedition into the interior of the Swan River Settlement, about ninety miles to the south-east of the mouth of the river. Two specimens of this very elegant little animal were seen by Lieutenant Dale, both of which fled to hollow trees for shelter upon being pursued. The district in which they were found abounded in decayed trees and ant-hills; and, from some peculiarities in the dentition of the animal, combined with its extremely long and slender tongue, it became evident that its food was insects, and the softer and smaller species, for procuring which, by scratching up the earth, the strong fore feet and claws appeared to be adapted. Indeed, the peculiarities of structure, combined with the fact that the animal was found in the vicinity of ant-hills, suggested that its food, in all probability, consisted chiefly of Ants: and hence the generic name. As yet, however, we have no direct evidence that Ants form the chief food of the Myrmecobius, though it is stated, in Mr. Gould's "Mammals of Australia," that wherever this animal takes up its abode, there Ants are found to be very abundant. In the same work the following particulars of the habits of the animal are given from the pen of Mr. Gilbert:—

"I have seen a good deal of this little animal. It appears very much like a Squirrel when running on the ground, which it does in successive leaps, with its tail a little elevated, every now and then raising its body and resting on its hind feet. When alarmed, it generally takes to a dead tree lying on the ground, and before entering the hollow, invariably raises itself on its hind feet to ascertain the reality of approaching danger. In this kind of retreat it is easily captured; and when caught, is so harmless and tame as scarcely to make any resistance, and never attempts to bite. When it has no chance of escaping from its place of refuge, it utters a sort of half-smothered grunt, apparently produced by a succession of hard breathings.

"The female is said to bring forth her young in a hole in the ground or in a fallen tree, and to produce from five to nine in a litter. I have not myself observed more than seven young attached to the nipples." It is not nocturnal in its habits.

With regard to the range of the genus Myrmecobius, Mr. Gould states that it is very generally dispersed over the interior of the Swan River Settlement, from King George's Sound on the south to the neighbourhood of Moor's River on the north, and as far westward as civilised man has yet been able to penetrate. Its species are also found near the Murray and Darling.

This many-toothed Ant-eating Marsupial has always been interesting to geologists, for in the Stonesfield slates of the Oolitic formation of England, which lie low down in the Great Oolite, the lower jaws of an animal have been found greatly resembling those of Myrmecobius. The fossil Amphitherium has the jaws but slightly inflected, and is not without resemblance to insectivorous creatures; but, nevertheless, its similarity to Myrmecobius struck Owen and Lyell many years since.

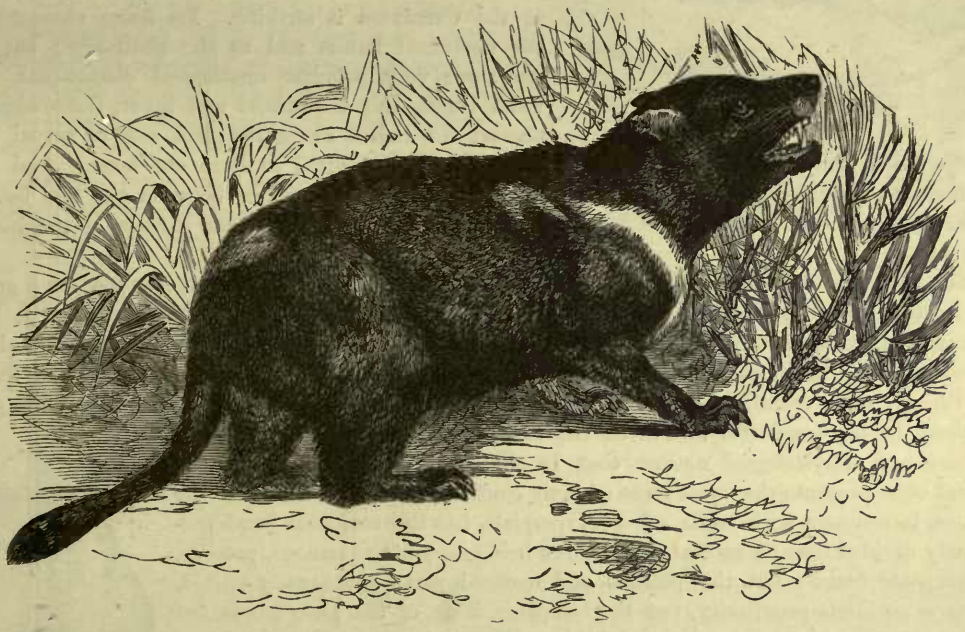
GENUS DASYURUS.—THE URSINE DASYURE.*

Being a great enemy of the poultry and tender rearlings of the colonists of Van Diemen's Land, this small creature has earned the name of the "Native Devil." It may be compared to a Bear, with

* *Dasyurus ursinus.*

a body about two feet in length, and the resemblance is tolerably correct in the fur, general proportions of the body and limbs, and also in its gait and its actions. The Dasyure, however, has a longer tail than the Bear, and never grows larger than a Badger. It is a short animal, with a round broad head and rather a long snout, and the coarse black fur (brown-black on the head, tail, and beneath) is marked by one broad white band across the chest and by another over the back, close to the tail. The tail is about half the length of the head and trunk. Harris notices that these animals were very common on the British first settling at Hobart Town, and were particularly destructive to poultry, and Mr. Gunn states that they commit great havoc among Sheep, and that notwithstanding their comparatively small size, they are so fierce that they are a match for any ordinary Dog.

As the settlements increased in Tasmania, and the ground became cleared, the animals were driven from their haunts near the town to the deeper recesses of the forests yet unexplored. They were easily procured by setting a trap in the most unfrequented parts of the woods, baited with raw



DASYURE.

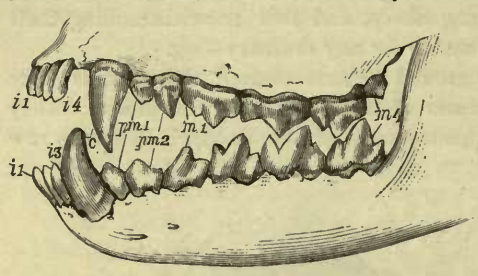
flesh, all kinds of which they will eat indiscriminately and voraciously. They also, it is probable, prey on dead fish and blubber, as their tracks are frequently found on the sands of the sea-shore. In a state of confinement they appear to be untamably savage, biting severely, and uttering at the same time a low yelling growl. A male and female which Mr. Harris kept for a couple of months, chained together in an empty cask, were continually fighting. Their quarrels began as soon as it was dark, as they slept all day, and continued throughout the night almost without intermission, accompanied by a kind of hollow barking, not unlike that of a Dog, and sometimes a sudden kind of snorting, as if the breath were restrained a considerable time and then suddenly expelled. They frequently sat on their hind parts, and used their fore paws to convey food to their mouths. The muscles of the jaws were strong, and they crushed the largest bones asunder with ease.

This Dasyure, like the others of the genus, has the incisor teeth equal, and there are eight of them in the upper jaw and six in the lower. The four canines are large, and there are two powerful premolars in each jaw and on each side. These are succeeded by four molars above and below, and on both sides of the mouth.

The incisor teeth, equal in size, are arranged in a semicircle in the upper jaw, and those of the lower jaw have a corresponding direction, but they are rather the stouter. The canines are well developed, and those of the lower jaw bite in front of those of the upper. They look eminently

adapted for stopping and seizing prey, and their carnivorous character is surpassed by that of the premolars and true molars. These last have a triangular grinding surface: the first has four sharp cusps, the second and third have five, and the last, which is the smallest in the upper jaw, has only three. In the lower jaw the last molar is of the same size as the last but one, and has four cusps; and the other molars have much resemblance to those in the upper jaw.

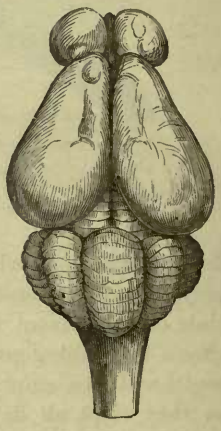
The hind feet have the toes separate and not united by a fold of skin, and there is a rudimentary great toe in this species. The condyle of the humerus is not perforated—as in the Kangaroos, for instance—for the passage of the blood vessels, but is whole, and the outside of the bone is marked by a groove, along which they pass.



TEETH OF THE DASYURE.

Although this Dasyure has the lower jaw inflected, and is a true Marsupial, the resemblance in shape, and in dental and other characters, as well as in its habits, to the Carnivora is striking. Its fierce character and the nocturnal habits add to the similarity; but there are some very peculiar anatomical distinctions. The wrist bones, called scaphoid and lunar, those which are nearest the radius along the first row of carpal bones, are separate in the Dasyure, but in the Carnivora they are united to form one bone. And in the foot there is a peculiarity: for whilst in the Carnivora there is a groove between the heel bone and the astragalus, this is absent in the Marsupial Carnivore, and the articular surface of the bones is continuous.

The Dasyures have a small crest of bone on the top of the skull, which is also seen on a grander scale in the Carnivora. They have, moreover, the zygoma well developed and strong; it bulges outwards and curves upwards, but not to the amount seen in the true Carnivora. The occipital bone is developed as in the non-Marsupial mammals, but its parts, instead of joining together and forming one with age, often remain separate; but this does not appear to occur in all the species of the genus, for Owen, in his wonderful article on the Marsupials in the "Cyclopædia of Anatomy and Physiology," notices that in the little *Dasyurus Maugei* the occipital bone presents the usual state of bony confluence. He notices that the Dasyure, in common with some other Marsupials, has the temporal bone permanently divided into its several parts, there being separate squamous, petrous, and tympanic bones; but the petrous and mastoid parts are usually united. This is a reptilian peculiarity, but the tympanic bone of the Dasyure is not without its resemblances to those of birds. The surface on which the lower jaw moves or is hinged, is not composed entirely by the temporal bone, but the malar bone is slightly included, and even the sphenoid comes into the joint.

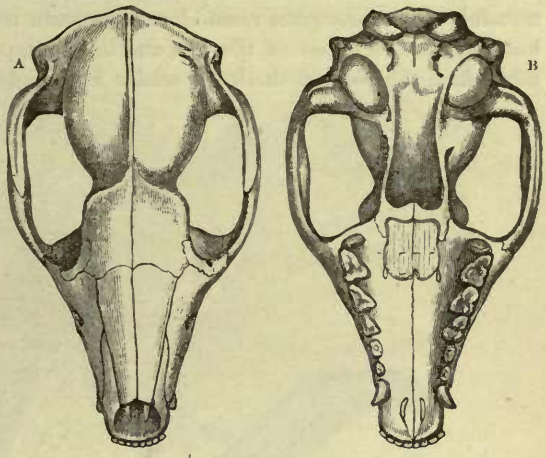

BRAIN OF THE DASYURE.

Another marked character of the Dasyures is, that their hard palates are not whole, but have spaces and perforations, and this denotes a low organisation. This absence of a perfect hard palate is seen in other Marsupials, and especially in the Bandicoots (Perameles).

The angular process of the lower jaw, where inflected or bent in, is triangular and directed upwards, with a blunt point; and the condyle of the jaw is low, being on a level with the molar teeth.

It is remarkable that the Dasyures should have the bones of the leg, the tibia and fibula, so connected together as to allow of a certain degree of rotation on each other, after the fashion of the fore-arm bones. The muscles of the leg are modified for the purpose. This interesting anatomical point recalls one of the great distinctions between the fixed leg bones of man and those of the hand-footed Ape. It is not found, however, in the non-Marsupial mammals, whose habits of life are simulated by the Dasyure; but it is found in the Wombat, a burrower, and in the Koala, Phalangers, and Opossums, which are climbers. In examining the stomachs of the Marsupials, Owen noticed that differences in food and habit are not met by alteration in the shape of the organ, as they are in the higher Mammalia. Thus, the common Dasyure, the insectivorous Bandicoot, and the leaf-eating

Phalangers, have a full round, oval, or sub-triangular-shaped stomach, with the right extremity projecting beyond and below the pylorus. The length of the stomach seldom exceeds the height by more than one-third. No cæcum is found in the carnivorous Marsupial, and the intestine is short and wide, being continued, like the intestine of a reptile, along the margin of a single and simple mesentery, from the pylorus to the rectum (Owen). The liver has a gall-bladder in the Dasyure, and there is a pancreas as well as a spleen. The heart is contained in a slight pericardium, as in the other Mammalia. The Ursine Dasyure is found in Van Diemen's Land only.



UPPER (A) AND UNDER (B) VIEW OF SKULL OF DASYURE.

There are several kinds of Dasyure, which have been carefully noticed and described. One is called the Long-tailed or Spotted Dasyure,* and is about the size of a Cat. The fur is reddish-brown, pencilled with yellow, and is spotted with white both on the body and on the tail. It has a tail as long as the head and body together, and the under parts of the body and the fore-legs and feet are of a dirty yellow tinge. It lives in Van Diemen's Land, and was, from its shape, at first called a Marten. The teats are six in number, three on each side, and seated within a slight fold only of the skin, so that there is no true pouch.

MAUGE'S DASYURE.†

This is a small animal, not larger than a half-grown Cat. It has a longish bushy tail, a broad head, and is somewhat of greyish-yellow colour. There are white spots on the sides of the body and tail. In confinement this little creature is torpid by day, but lively as evening comes on, and it rushes about, with its tail extended, with great rapidity. It is very injurious to the poultry when in a wild state, and is called the Wild Cat in Van Diemen's Land. A variety of it is the Viverrine Dasyure, which has the head and body spotted with white, the general colour being brown, black, or grey, tinted with yellow, the under parts being white. It has long hairs to its tail; rather large ears, the flesh of which is of a pale pink, as is that of the naked lips, the tip of the nose, and the soles of the feet, the latter being hairless, but covered with small fleshy tubercles. There is no trace of an inner toe to the hind foot, unless it be a slight swelling of the flesh, marking the situation of the rudimentary bone beneath. Both of these animals are to be found in New South Wales and Van Diemen's Land.

The rest of the Dasyures are widely spread over the continent. The smallest kind is the North Australian Dasyure. Geoffroy's Dasyure, which has a thin tail and an inner toe to the hind foot, inhabits Western and Southern Australia and New South Wales, is a great killer of the Yellow-crested Cockatoo, and they hunt and kill Mice or Rats as well as any Cat. They have not a pouch.

GENUS THYLACINUS.‡—THE DOG-HEADED THYLACINUS.§

This is a Dog-like, slim, narrow-muzzled animal, with clean and rather short limbs, a foxy head, and a tail about half as long as the body, which in males is forty-five inches in length. It is about the size of a Jackal, and the fur is short, but rather woolly and greyish-brown, faintly suffused with yellow in colour. The fur on the back is deep brown near the skin, and yellowish-brown towards the tip. It has from twelve to fourteen black bands on the body, and the tail has long hairs at the tip only. The eyes are keen, large, and full, and they are black and have a nictitating membrane.

* *Dasyurus macrurus*, or *maculatus*.
† *Dasyurus Maugei* (Geoffroy).
‡ θύλακος, a pouch.
§ *Thylacinus cynocephalus*.

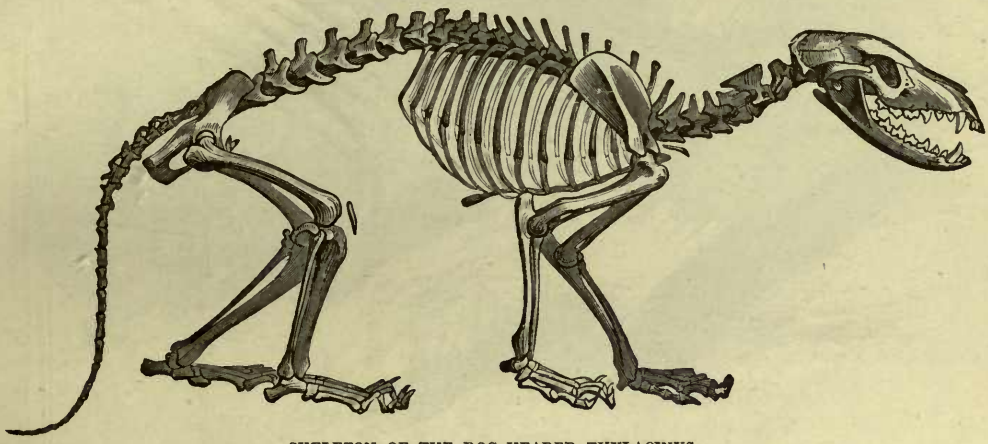
The animal walks half on its toes and half on its soles or palms, and thus is a semi-plantigrade, the body being brought nearer the ground than that of the Wolf in running. There is a marsupial pouch, but the bones are mere cartilages. The Dog-headed Thylacinus, or the Zebra-Wolf of the colonists of Van Diemen's Land, thus described, has often been taken for one of the Carnivora, and certainly there are great resemblances between it and the Dogs. The canine teeth are of large size, but they are recurved at the top, and in the upper jaw are separated from the incisors by a space, into which the point of the lower canine fits when the jaws are closed. This is different in the Dogs,

DOG-HEADED THYLACINUS.

whose lower canine passes on the outer side of the upper one when the mouth is closed. The premolar of the Thylacinus has a small cusp behind, but in the lower jaw the premolars are isolated, and do not form a continuous cutting and masticating ridge. It is also to be remembered that this animal has a peculiar lower jaw, as it is one of the Marsupials, and the angle is inflected. It is a Marsupial, with some structures which foreshadow those of the more highly-developed Dog.

Mr. Harris, who was the first to make this animal known, states that it lives among caverns and rocks, in the deep and almost impenetrable glens, in the neighbourhood of the highest mountains of Van Diemen's Land. The specimen from which his description was taken was caught in a trap baited with Kangaroo's flesh; it remained alive but a few hours, having received some internal hurt whilst being secured. From time to time it uttered a short guttural cry, and it appeared exceedingly inactive and stupid, and, like the Owl, had an almost continual motion of the nictitant membrane of the eye. Remains of an Echidna were found in the stomach of the animal. Waterhouse states,

on the authority of Mr. Gunn, that these animals are common only in the remoter parts of the colony, and used to be frequently caught at Woolnooth and the Hampshire Hills. They attack the Sheep at night, but are occasionally seen during the daytime, upon which occasions, perhaps from imperfect vision, their pace is very slow. Mr. Gunn also observes that the Thylacinus sometimes attains so large and formidable a size, that a number of Dogs will not face it. That gentleman denies that the



SKELETON OF THE DOG-HEADED THYLACINUS.

tail of the animal is compressed, as has been stated by some authors, and his observations do not confirm the aquatic habits which have been attributed to it. There are cartilages in the place of the marsupial bones; but the pouch is well developed in the female Thylacine, and there are four well developed teats, each four inches long, indicating that it may contain four young ones at a time. The marsupium, or pouch, opens backwards, not, as in the Kangaroos and most others, forwards.

GENUS PHASCOGALE (POUCHED WEASELS).—THE BRUSH-TAILED PHASCOGALE.*

This genus includes many species of small Weasel- or Rat-like Marsupials. They are small, insectivorous, and climb shrubs and trees in pursuit of their prey. The largest known is about the size of a common Rat. The brush-tailed kind inhabits New South Wales, South Australia, and Western Australia, and is a pretty little animal, having a long and soft fur, of a grey colour above and white or yellow-white under the body. The eyes are encircled with black, and there is a pale spot above and below the eye, and the hairs are blackest along the middle of the head. The ear is rather large and not furry; the tail is about equal to the body in length, or seven inches to nine inches, and there is a portion near its end of about two inches in length, which is clothed with short, stiff hairs, and the rest has long and glossy hairs, sometimes an inch or two long. An insectivorous little creature, its teeth are modified to meet its diet, and they are less carnivorous than the other Dasyurids. They have the two foremost incisors of the upper and lower jaw larger than the others. There are three premolars in each jaw on each side, and eight molars above and below, which are studded with prickly tubercles, those of the upper jaw having triangular crowns. There are five toes to the fore and hinder extremities, and the inner toe of the latter is in the form of a small nailless prehensile thumb. The brain-case is large and the skull comparatively smooth. The species just noticed is said to enter the stores of the settlers, and it makes a nest in the hollows of the trunks of trees or in the branches. The female has no pouch, but ten teats covered with hair. It is the Tapoa Tafa of White, according to Krefft.

Another species, about six inches long, not including a tail of three inches—the Freckled Phascogale—lives in the Swan River district and at King George's Sound, being generally distributed over Western Australia. It has the fur freckled with black and white on the head and fore parts of the body. Mr. Gilbert found insect remains in its stomach, and he obtained a female specimen having

* *Phascogale penicillata.*

BRUSH-TAILED PHASCOGALE.

seven young attached. They were little more than half an inch in length, and quite blind and naked. Above the teats of the mother is a very small fold of skin, from which the long hairs of the under surface spread downwards, and effectually cover and protect the young. This fold is the only approximation to a pouch which has been found in any species of this genus. The young are very tenacious of life, and those just mentioned lived nearly two days attached to the mammæ of the dead mother.

The Yellow-footed Phascogale is a kind which inhabits New South Wales and South Australia, and the White-footed Phascogale and a closely-allied kind live in South Australia and Van Diemen's Land. In New Guinea, which constitutes a part of the Australian natural history province, there is a black, short-eared, and short-furred kind, about the size of a Rat, called *Phascogale melas*.

ANTECHINUS.

UNIV. OF CALIFORNIA

OPOSSUM AND YOUNG.

There is a little kind, measuring only three inches in length, with white fur everywhere, except on the upper parts, which are ashy grey; and in Western and Southern Australia there is one which has great ears, very slender limbs, and a short and thick fat tail. It looks like a large-eared, fat-tailed Mouse, and is under four inches in length. All these kinds of Phascogale, except the brush-tailed one, belong to a group with very short hairs on the tail, and are sometimes classified under the name Antechinus, the thick-tailed one being termed Podabrus; and they all have shallow pouches.

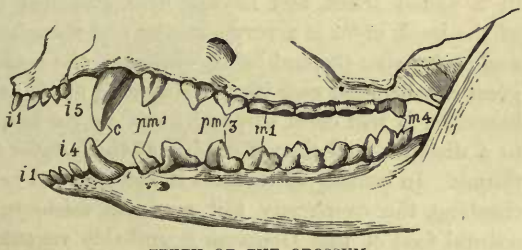
CHAPTER III.

THE OPOSSUMS.

Prehistoric Opossums—Description of the Animal—Their Teeth—Habits—The Common Opossum—D'Azara's Opossum—The Crab-eating Opossum—The Thick-Tailed Opossum—Merian's Opossum—Pouchless Opossums—Their Young—The Murina Opossum—The Elegant Opossum—The Yapock—Classification of Marsupial Animals—Geographical Distribution of the Sub-Order—Ancestry of the Marsupials—Fossil Remains.

VI.—THE OPOSSUM FAMILY.—DIDELPHIDÆ.

The Marsupial animals included in this family are not found in Australia or in Van Diemen's Land, or in any part of the natural history province to which those countries belong. They are numerous, however, and are now living on the American continent; but formerly some inhabited Europe during that geological period which is called the Eocene. The Opossums are very rat-like in form, the largest species being about the size of a large Cat, but they have the snout more elongated; and in some species in which the individuals are large the body is proportionately stout, and on most there is a comfortable fur, with short and long hair. The tail is almost always very long, nearly destitute of hair, excepting at the root, and is covered with a scaly skin, there being a few scattered hairs. It is a useful organ, for the Opossums hang by it, and it assists them in climbing and descending trees, and in holding on, when they are young, to their parent. The ears are rather large and round, the eyes are placed rather high up in the face, and the long muzzle ends in a naked snout. The legs look short for the body. The feet are naked beneath; there are five toes, and the great toe is more or less opposable to the foot, and acts like a grasping thumb. Each toe is furnished with moderate-sized claws, excepting the inner toe of the hind foot, which is clawless. The Opossums are remarkable for the great number of their incisor teeth, there being ten in the upper and eight in the lower jaw, and they are arranged in a semicircular manner. The upper and two foremost incisors are rather longer than the rest, and are generally separated from them by a narrow space. They are nearly cylindrical and expanded at the tip. The canines are well developed, the upper ones being the largest. There are three premolars on each side of both jaws, and they have two roots, and are compressed and pointed. There is a posterior talon to them. The molars, eight in each jaw, have three roots, and those of the upper jaw have the crown of a triangular form and tubercular, whilst those of the lower jaw are longer than broad, and each has the appearance of five prickly cusps on its upper surface.

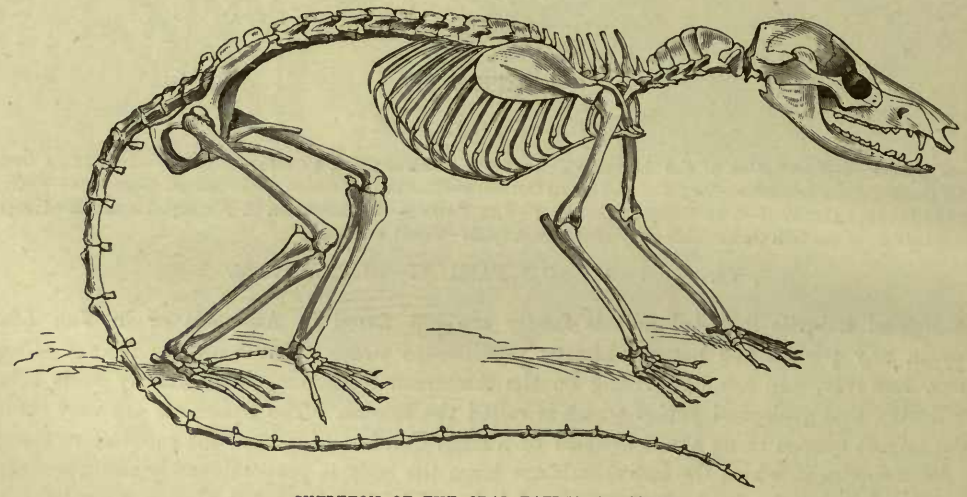


TEETH OF THE OPOSSUM.

Some of the Didelphidæ have no marsupium, or pouch, or it is very slightly developed, and in these particular kinds the young, after having left the nipples, are carried on the back of the mother, retaining their position by twining their tails around hers. The mammæ are numerous: there may be as many as thirteen, an odd one being found in the centre of the ring of the other nipples.

The Opossums are active, sly, and very intelligent in certain things, and their food consists of insects, small reptiles, birds, and eggs. Living for the most part in trees, they secrete themselves in

the hollows of the branches and trunks during the daytime and sally forth in the night. They have a moderate-sized cæcum. It must be noticed that the great toe of the hind foot is well developed, has no nail, and enables the creature to grasp, and is thus very useful; and that they walk plantigrade. The ankle and leg have the same movements as in the Wombats, and the same general anatomy. If the members of the family are compared with those of the families which live in the Australian province, it will be found that they most resemble the Perameles and Dasyures. The Opossums may be divided into three groups: those whose pouch is well developed, those in which it is a mere fold, and those which have webbed feet and live in the water, like Otters.



SKELETON OF THE CRAB-EATING OPOSSUM.

THE COMMON OPOSSUM.*

This is a large kind, and is about the size of a common Cat, and its long, large, pointed head, ending in a naked snout, and having eyes encircled in dusky brown fur amongst the white hair and fur of the head, gives it a very cunning and thoughtful appearance. The ears are black. The tail is long and prehensile, the end being white and the rest black, and the legs and feet are brownish. It is a great climber, and uses its tail almost as much as some of its Monkey companions. Running along the branches, it will often suspend itself by its tail, and give a swing and let go, thus launching its body to a distance, and then it catches at the boughs with its feet and unclawed but prehensile hind toe-thumb. In coming down trees it uses the tail to steady itself, and to prevent too rapid a fall; and in climbing, the ever-ready tail prevents mishaps, should the clawed toes not grasp sufficiently. The natural food of this Opossum is probably vegetarian, but it is a great birds'-nester; it will eat roots and fruits, but the early settlers found it very destructive to their poultry, for it catches the birds and sucks their blood, not eating the flesh: consequently, it has been much hunted, and as the fur and skin are sometimes used, the destruction of the Opossum has been great. It is a curious creature, and seems to have gained experience in its struggle with man, and as many stories are told of its cleverness as there are about Reynard the Fox and the Indian Jackal. It will sham death in a most persevering manner, and is at the same time very tenacious of life.

The skull has strong temporal ridges, which form a sagittal crest, and the arch of the zygoma is well grown. The animal has a longer facial part of the skull and a smaller brain-case than the other Dasyures, and the brain has large olfactory or front lobes. The cerebral hemispheres are small, and there are no convolutions. This is essentially a North American animal, and is found from Mexico to the Southern States inclusive.

The female brings forth from twelve to sixteen young at a time, and her nest, which is formed of dry grass, is usually at the root of a tree or bush. When first born, the young are said not to be

* *Didelphys virginianum.*

more than a grain in weight, and blind, naked, and shapeless. They find the teats in the mother's pouch, unless she places them on to them with her mouth, and they cling on so as not to be separated except by violence. In about five days, so rapid is their growth, they have reached the size of a Mouse, and all their parts are developed. They then leave the pouch, and return to suckle and when danger appears. During this time the female shows great attachment to her young; and Mr. Waterhouse, from whose work these descriptions are taken, states that she will suffer any torture rather than permit the pouch to be opened.

CRAB-EATING OPOSSUM.

AZARA'S OPOSSUM.*

This is a smaller animal than the common or Virginian Opossum, but its tail is long in proportion to its body. It is the South American representative of its larger fellow species, and is found over a very wide extent of country. It was noticed by the celebrated naturalist D'Azara in Paraguay; Mr. Darwin found it at Maldonado, La Plata; and specimens have been obtained from the Brazils, Santa Fé de Bogota, and Bolivia. This is because it is not entirely a forest animal, but is found occasionally in the open country. It may be distinguished from the common Opossum by three distinct black marks on its head, by its large tail, one-third of which is covered with fur like that on the body. The rest of this important member is scaly, with small hairs springing from between, the

* *Didelphys D'Azaræ.*

scales being black in the second third, and white at the tip in colour. The habits of this Opossum are nocturnal, and it lies concealed by day in burrows in the ground or in thickets. At night it climbs trees to feed upon fruits and birds' eggs. It will chase and catch sleeping birds, and suck their blood like a Weasel.

THE CRAB-EATING OPOSSUM.*

A small Opossum, with a long black tail tipped with white, and a dull-coloured fur to its body, lives in Brazil and Guiana, and has a very omnivorous disposition. Preferring swampy situations, it lives mostly on the trees, hunts small birds and insects, and even catches a reptile now and then, but its fondness for the Crustacea of the swamps is proverbial, and hence its name of Crab-eater.

Another species is interesting from being found in the part of California which adjoins Mexico. The Short-headed Opossum also belongs to this group, and is from the same locality. Besides these, there are several smaller pouch-bearing Opossums, without the long hair of those just mentioned, and they are from Brazil, Guiana, and Surinam—for instance, the Quica, the Naked-tailed, and the Four Spotted kinds. The Philander Opossum is a bird-hunter, and lives in Surinam.

The next group of Opossums have no pouch, but there may be folds of the skin protecting the mammæ.

THE THICK-TAILED OPOSSUM.†

As its name implies, this pouchless Opossum has a very thick tail. Moreover, it has smaller ears than the other Opossums, and has a short head and short legs. The fur is made up of harsh hairs, which are close to the body, and there is but little under fur. Its colour is yellow-brown, but the eye and muzzle are brownish, and the tail, with the terminal two-thirds, is black, with the exception of a small white spot at the end. It inhabits Brazil and Paraguay, and extends southwards to the River Plate. One of the Opossums was kept by D'Azara, who found it quiet, tame, and stupid; but having been fed on raw meat, and a parrot happening to come too close, it killed the bird in a moment. There are folds of skin in the lower part of the abdomen, but no pouch, and there are six mammæ.

Another of the Opossums is called Merian's Opossum, or *Didelphys dorsigera*, and it inhabits Surinam. It was described by Madame Merian in 1717, who represented it in her great book on

MERIAN'S OPOSSUM.

insects with its young clustered on its back and hanging on to the mother's tail, which was curved over its back, with their little tails.

* *Didelphys cancrivora.* † *Didelphys crassicaudatus.*

It is very curious that the young of these pouchless Opossums should resemble those of the whole order in being comparatively little advanced in their development at the time of their birth. The young are at first strongly attached to the teats of the mother, and when they are sufficiently strong and grown to leave them, occasionally she takes them off from the nipples and places them on her back. Here they cling on with their tails to hers. Hence the name of back-bearing, or Dorsigera, which is given to this kind.

YAPOCK.

It was at first supposed that this method of carrying the young was restricted to this species, but subsequent experience has shown that several kinds do the same thing.

Two or three other species of Opossum are interesting from their small size and habits. Thus the Murina Opossum (*Didelphys murina*), with a very long tail, inhabits Guiana, Brazil, Peru, and Mexico. The body is about five inches in length, and the tail is either slightly longer or about the same. Yet this little thing attacks birds and insects; it burrows in the ground, and climbs trees to get its insect food.

The Elegant Opossum (*Didelphys elegans*), of Chili, is still smaller than the last, and frequents the thickets growing on the rocky hills near Valparaiso. They are numerous, or were so when Mr. Darwin observed them, and are easily caught in traps baited with cheese or meat. The tail appeared to be rarely, if at all, used as a prehensile organ; yet they could run up trees with some degree of facility. It is an interesting fact that some of the smallest Opossums prey upon Lizards and Snakes as large, and even heavier, than themselves.

The last section of the Opossums contains the Water Opossum,

THE YAPOCK.*

This animal has a perfect pouch, and has large hind feet, the toes of which are united by a web. The fore feet are moderate-sized, and the pisiform bone is unusually long. Its habits are aquatic.

* *Chironectes variegatus.*

The Yapock has large naked ears, and a long, almost naked, tail, and is altogether rather larger than the common Rat. Its method of life is very much the same as that of the Otter. It is a good diver, and feeds upon crustaceous and other aquatic animals. It is a native of Guiana and Brazil.

The Marsupial animals assume the general shape and habits of many orders of Mammalia which have no marsupium, and which live in the other great natural history provinces. Thus there are Marsupial animals like Dogs, Rats, Squirrels, Flying Squirrels, Deer, &c. They have, therefore, many methods of life as a group, and, as might be expected, the brain and nervous system present many differences in them. In all, the front lobes of the brain which deal with the sense of smell are very large, and in some, such as in the Carnivorous Marsupials, they are exposed, and not covered by the main mass of the brain. In the Kangaroos, however, these olfactory lobes are hidden more or less. These last also have well-marked convolutions on the brain which are nearly wanting in those first mentioned.

The Marsupial animals just considered have been classified to a certain extent during their descriptions, but it is necessary to recapitulate. They are arranged in groups of genera or species, or into families. They are as follows :—

ORDER MARSUPIALIA.—SUB-ORDER MARSUPIATA.

Family	Macropodidæ	Genus	Macropus . . Kangaroos.*
		,,	Dendrolagus . Tree Kangaroos.
		,,	Hypsiprymnus . Potoroos.
		,,	Hypsiprymnodon The Hypsiprymnodon.
,,	Phascolomyidæ	,,	Phascolomys . The Wombat.
,,	Phalangistidæ	,,	Phascolarctus . The Koala.
		,,	Phalangista . The Cuscus. Dormouse Phalanger. Phalangers.
		,,	Petaurus . . Flying Phalangers.
		,,	Tarsipes . . Tarsipes.
,,	Peramelidæ	,,	Perameles . . Bandicoots.
		,,	Chœropus . . Chœropus.
,,	Dasyuridæ	,,	Myrmecobius . Ant-eaters.
		,,	Phascogale . . Phascogale.
		,,	Dasyurus . . Dasyures.
		,,	Thylacinus . . Dog-headed Thylacinus.
,,	Didelphidæ	,,	Didelphys . . Opossum.
		,,	Chironectes . Yapock.

The Macropodidæ, Phalangistidæ, Peramelidæ, and Dasyuridæ are found living somewhere or other in the Australian distributional province, which includes the mainland, Tasmania to the south, and the Molucca and Arru Islands to the north, bounded by the Straits of Lombok, and Celebes, New Guinea, New Ireland, Timor, Amboyna, Banda, and Waigeoe. Each family is not represented fully, however, in all the remarkably separated divisions of the province. Thus the genera Macropus and Dendrolagus of the first family, Petaurus and Phalangista of the third, Perameles of the fourth, and Phascogale of the Dasyuridæ have been found in New Guinea ; but in other islands, such as Celebes, and in those from Lombok to Timor, the genus Cuscus alone is represented. In the Moluccas, Cuscus and the genus Petaurus are found. In Van Diemen's Land about one-half of the species are peculiar to the island, and the remainder are found also on the eastern districts of the mainland. It has Kangaroos, Potoroos, Wombats, Phalangers, Bandicoots, and three out of the four genera of Dasyuridæ. Western Australia, which is such a remarkable botanical province, and is so separated by desert and sand from the east, has numerous Kangaroos, Potoroos, Phalangers, Bandicoots,

* The sub-genera Halmaturus and Heteropus, Osphranter, Lagorchestes, and Petrogale, are included in Macropus, and many other sub-genera relating to the other families merely complicate the classification. Bettongia, Potoroüs, are sub-genera or artificial groups of the genus Hypsiprymnus ; Cuscus, Trichosurus, Pseudochirus, and Dromicia, are groups of Phalangistidæ ; Petaurista, Belideus, and Acrobata are divisions of the genus Petaurus ; Macrotis is a sub-genus of Perameles ; Antechinus is a division of the genus Phascogale ; Sarcophilus is a sub-genus of Dasyurus. These are unnecessary sub-divisions.

Phascogales, Dasyures; and, in common with South Australia, a Chœropus, whilst the genus Tarsipes is peculiar to it. The Wombat is found in Van Diemen's Land and some of the islands in Bass Strait. It is found in the south and east of the mainland of Australia, but not to the west and north. Mr. Waterhouse notices that the Marsupials of the eastern districts are for the most part distinct from those of the opposite side of the continent, there being, when his great work, which has been so constantly referred to in this description, was written, but eight species out of upwards of sixty inhabiting the two provinces. South Australia is the habitat of more common species than elsewhere. The northern part of Australia has more species peculiar to it than the other divisions, and some of its Dasyuridæ especially, and species of Cuscus also, are found in the Arru and other islands to the north. The metropolis of the sub-genus Cuscus is in the Moluccas, where two species are widely distributed, or one is restricted to certain islands.

The other divisions of the genus are represented by the Vulpine Phalanger, an animal with long loose fur, which inhabits New South Wales, Western Australia, and North Australia; by Cook's Phalanger, of New South Wales and Van Diemen's Land. The genus Perameles, the Bandicoots, has species in Van Diemen's Land, Australia, New Guinea, and in the Arru Islands, and the genus Petaurus has a corresponding distribution. The Didelphidæ are found in the United States, California, Mexico, Peru, Guiana, Brazil, Paraguay, Banda Oriental, and Chili; and Brazil is the country where they abound the most in species and individuals, the number diminishing to the north and south.

The Marsupials have a great ancestry, and some of them lived when the continents and oceans of the earth were in very different relative positions to those they now occupy. Indeed, it is most probable that the fossil remains of the most ancient mammal belong to this order. There is a small double-fanged molar tooth of a mammal which was found by Plieninger, in 1847, contained in a jumble of shells and of the remains of reptiles and fishes in strata beneath the Lias formation of Diegerloch, near Stuttgart. It and another which was discovered close by, by the same professor, belonged to animals which were dead when this topmost stratum of the Trias, immediately beneath the Lias, was being formed. They are Triassic in age, therefore, and they somewhat resemble the back teeth of a fossil which was found subsequently in the Purbeck strata of England, and which evidently belonged to a Marsupial more or less resembling the existing Kangaroo-Rats or Potoroos, of the genus Hypsiprymnus. Later on, Professor W. Boyd Dawkins, F.R.S., discovered a small tooth belonging to the same extinct genus as that which included Plieninger's fossil, namely, Microlestes; and its resemblance to one of Hypsiprymnus is even greater. Its position was high up in the Trias of Watchet in Somersetshire. Mr. Charles Moore, of Bath, had previously found many specimens of teeth of the same family in a fissure, down which they had been washed by the Triassic sea.

A lower jaw of a small Mammal was found in the Trias of North America by Emmons; and it has on one side three incisors, one long canine, then a diastema, three premolars, and seven molars with three points. It is therefore one of the Myrmecobius group.

After the age of the Trias, when there was much continuous land surface, Europe was broken up into a coral island tract, during the age of the collection of the Jurassic deposits. The islands were tenanted by many small Marsupials, four species of which have been discovered in the deposits of Stonesfield slate at the bottom of the Great Oolite. They belong to the extinct genera Amphitherium, Phascolotherium, and Stereognathus, and the first somewhat resembled the Myrmecobius of recent times; but all that can be said is that they belonged to Marsupial animals. Piled on the Stonesfield slates are many hundred feet of strata, and high up amongst them, in the Swanage and Purbeck districts, are deposits in which Messrs. Brodie and Beckles have found portions of the skeletons of numerous insectivorous Marsupials, of which the genera Spalacotherium, Plagiaulax, Triconodon, and Galestes are the most important. They were small, as a rule, and there has been much debate regarding their affinities with modern insectivorous forms, and they are still surrounded with doubt.

The appearance of the Mammalia without pouches took place in the Eocene age, and in the Old and New World, and contemporaneously with them lived in France a kind of Opossum, some of whose bones were found in the strata of Montmartre, near Paris; and in later Tertiary strata other relics have been found. These are the only instances of a fossil Didelphid occurring out of the New World; and there, where the Opossums are now characteristic animals, they were present in the last geological age, for in the Brazilian latest deposits remains of several species of Didelphys have been found.

Remains of these fossil Opossums have been found in the North American Pliocene deposits. The more ancient deposits of Australia have not yielded the remains of any of the animals which are now so peculiar to the province, but in the bone caves of the Wellington Valley, some two hundred and ten miles west of Sydney, Sir Thomas Mitchell discovered a mass of bones, forming a breccia with limestone, which contained numerous and most interesting Marsupial remains. In deposits of the same late age, and in bogs and gravels in Queensland, other remains were found. They were described by Sir R. Owen in one of his greatest works, and they belong to the Australian families of Marsupials, and not to the American Didelphidæ. As was usual elsewhere before the appearance of man on the earth, and contemporaneously with him for awhile, many of the kinds which resemble more or less those now living, or would be classified in the same family, and perhaps in the same genus, are gigantic. Owen distinguished among the bones those of large fossil Marsupials which belong to the Macropodidæ, and which may be arranged as subdivisions of the genus Macropus or Kangaroos, and of a powerful creature called Thylacoleo, or Pouched Lion, which must be admitted as a new section of the Macropodidæ, and whose habits were probably carnivorous, although there is much diversity of opinion on the subject, some of the most distinguished anatomists believing the creature to have been of an innocent disposition, although appearances are much against it. It is more closely allied to Plagiaulax, of the English Purbeck beds, than to any other form, and they well fit in between the genera Macropus and Hypsiprymnus.

A huge Marsupial, with a skull three feet in length, with teeth, in front especially, on the Kangaroo plan, and with longer fore limbs and shorter hind ones than the last-named animal, was described by Owen. The pelvis, however, has but two sacral vertebræ, and its ilio-pubic process would ally it with the Macropodidæ. This Diprotodon was an herbivorous animal, and was of the size of a Rhinoceros. This great Marsupial had fore limbs which possessed the power of rotation, and it was not without some characters which are seen amongst the Wombats. It appears to have had a great range, for its remains have been found in the caverns in the Wellington Valley, at Welcome Springs, South Australia, Hergolt's Springs, 500 miles north of Adelaide, near Melbourne, in the valley of the Condamine River, and widely over Queensland. A slightly smaller animal, called the Nototherium, also existed with the larger one.

The species of this genus have no lower incisive tusks, and a very short chin; the angle of the jaw is curved inwards, and there were only four molar teeth on each side in both jaws, and they were with two strong roots or fangs. It was probably one of the Macropodidæ. Others of this family are allied to Dendrolagus, and form the genera Protemnodon and Sthenurus. The Wombat was represented in the age of the great Marsupials; and both large and small species, one being of the size of the Tapir, have been described from bones and teeth which were found in the cave deposits of Australia. Remains of a Marsupial animal, probably of the Vulpine Phalanger, were found in the same caves, as were also some referable to the genus Perameles, or Bandicoots, and to the Potoroos. Several fossil species of the family Dasyuridæ have been found in the Australian caves, and one of them is referable to a section of the genus Dasyurus, which at present is restricted to Van Diemen's Land, it being somewhat like *Dasyurus ursinus;* moreover, probably, there was a species of Thylacinus present also. So far as is known from the researches of Owen amongst this wonderful cave fauna, no members of the family Didelphidæ occur there. They were American then, as they are now.

CHAPTER IV

SUB-ORDER—MONOTREMATA.*

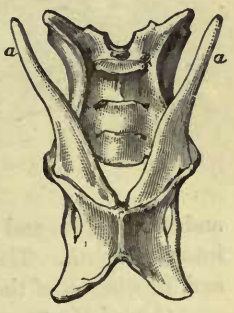
THE PORCUPINE OR LONG-SPINED ECHIDNA AND DUCK-BILLED PLATYPUS.†

Why the Monotremata are formed into a Sub-order—The lowest of the Mammalian Class—THE PORCUPINE OR LONG-SPINED ECHIDNA—An Ant-eater, but not an Edentate—Its Correct Name—Description of the Animal—Habits and Disposition—Manner of Using the Tongue—Where it is Found—Anatomical Features: Skull, Brain, Marsupial Bones—The Young—Species of Van Diemen's Land and New Guinea—THE WATER MOLE, OR DUCK-BILLED PLATYPUS—The most Bird-like Mammal—Various Names—Description—Their Appearance and Movements in Water—Their Burrows—Habits of an Individual kept in Confinement—Used by Natives as Food—How they are Captured—The Young—A Family in Captivity—the Snout—Jaws—Teeth—Tongue—Fore and Hind Feet—Heel—Spur—The Shoulder Girdle—Breastbone—Concluding Remarks on the Sub-orders—Postscript on the Monotremes.

THE PORCUPINE OR LONG-SPINED ECHIDNA.

THIS animal is the first example of some Marsupial beasts which are separated into a sub-order, because, in addition to the marsupial bones, there are some internal points of construction which are more bird- and lizard-like than those of the Kangaroo tribes. It contains animals which are the lowest of the Mammalian class, and are found only in the Australian natural history province. The Porcupine Ant-eater, as its name implies, has somewhat the shape of a Hedgehog or Porcupine, and it is fond of burrowing with its peculiar limbs, as well as of eating Ants with the assistance of its long tongue. But its internal anatomy and the construction of the skeleton differ from those of the true Ant-eaters, which belong to the order Edentata. It was called Ant-eater by its first describer (Shaw) in 1792, but a few years afterwards it was decided to belong to the same group as an animal about to be described—the Duck-billed Platypus, or Water Mole—and Cuvier, whilst believing that they both belonged to a peculiar order, separated this false Ant-eater from the Water Mole as a species and genus. He called this Hedgehog-like creature Echidna, from the presence of a spur on the heel, which is perforated, and which was erroneously supposed to be poisonous, like the fang of a Viper (Ἔχιδνα). The correct name is the Long-spined Echidna, or the Porcupine Echidna (*Echidna hystrix*).

The creature greatly resembles a Hedgehog with a very long snout, at first sight, but a slight examination will show that it differs much from the insect-eating and spiny little Hystrix. The Echidna is about a foot in length, and the upper part of its short body is covered with strong spines, and the rest is hairy, the front of the head, and the long, slender, and tapering snout being naked. The legs are short and strong, and the five toes of the fore leg have large and strong claws. This is in order to permit the creature to bury itself in sand and soft earth quickly, and this operation is assisted by a broad and rounded nail on the inner toe of the hind foot and by large claws on the other toes, and especially by a long nail to the second toe. A very long and flexible tongue enables the creature to catch prey. There are no teeth. The skull, when the skin and flesh have been removed, has a very pear-like appearance. It is a great burrower, and manages to get out of the way of observers as soon as is possible, for working actively with its strong limbs and claws, it pokes its snout into the earth and soon gets out of view. Ants are its favourite food, and they are captured in the same way as by the Great Ant-eaters belonging to the Edentata: for in both there is a long slimy tongue, which can be poked far out of the mouth into Ants' nests. The saliva required to make the tongue sticky comes from large glands under the lower jaw from the ear on to the fore part of the chest. When the Ants have collected on the sticky tongue it is taken into the mouth, and they are swallowed. The absence of teeth is made up by the presence of horny spines on the palate and tongue, which look backwards, and these crush and direct



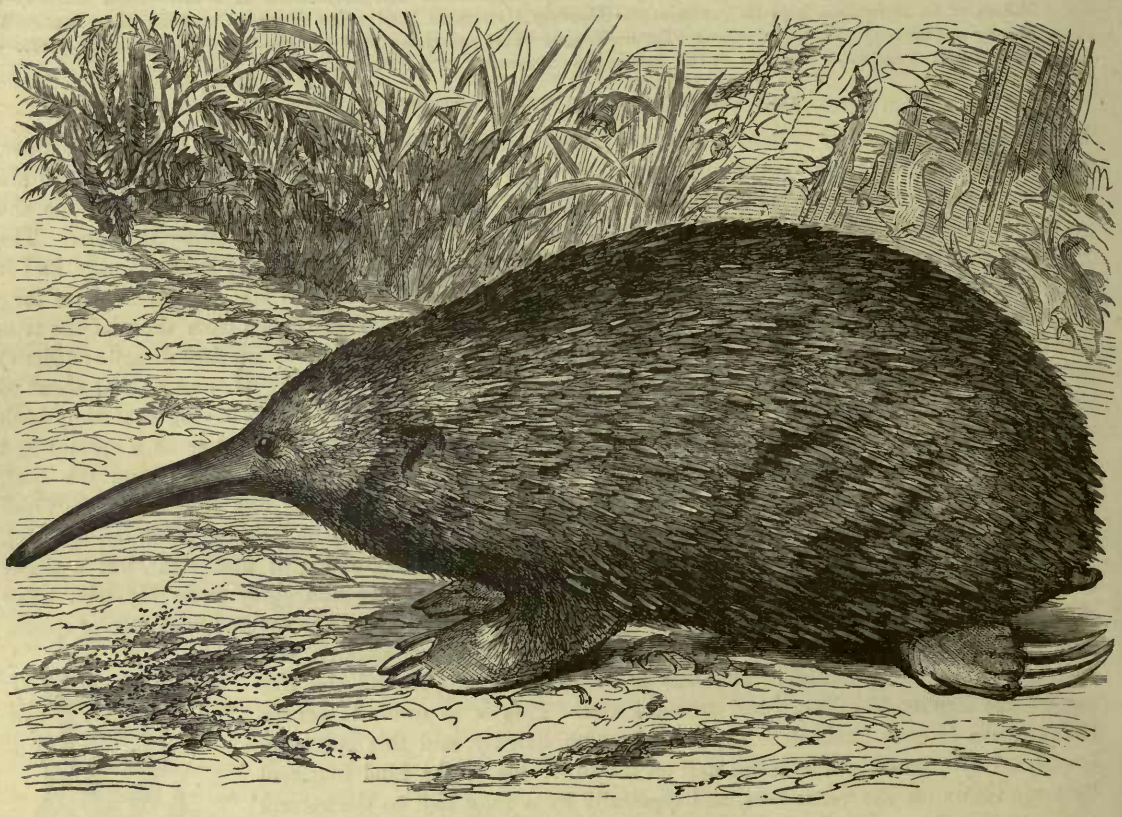
PELVIC ARCH OF THE ECHIDNA.
(*a a*) Marsupial Bones.

* μόνος, one; τρῆμα, opening.

† *Echidna hystrix* (Cuvier). Much confusion has been produced by Illiger, who changed the generic title to Tachyglossus, ταχύς, quick, and γλῶσσα, tongue; but the name given by Cuvier must stand, except in the minds of those zoologists who delight in novelties, and believe that the use of long words carries wisdom. Lately more confusion has been produced by the introduction of the generic term *Acanthoglossus*, which we do not admit or use.

the food to the throat. It is an apathetic and stupid animal, and usually tries to get out of the light, and it will lie and roll itself up, but not so successfully as a Hedgehog. One of the first which was seen was attacked by the Dogs of two of the travellers, Bass and Flinders, whose names are so familiar from places having been named after them in Australia. The Dogs did not come off victorious, for the new animal burrowed in the loose sand, but not head foremost; it sank itself directly downwards, and left its prickly back just on a level with the surface.

An Echidna was watched, so that the manner in which it could use its tongue was observed. Ants could not be had, but a diet of chopped-up eggs, liver, and meat was readily received, and it was noticed that the tongue was used in the same manner as that of the Chameleon, by simple protrusion



PORCUPINE ECHIDNA. (*After Gervais.*)

and bringing in, and also as a mower moves his scythe, it being curved sideways, and the food swept into the mouth. The Echidna is fond of water and milk, which are licked up by a rapid putting out and drawing in of the long tongue.

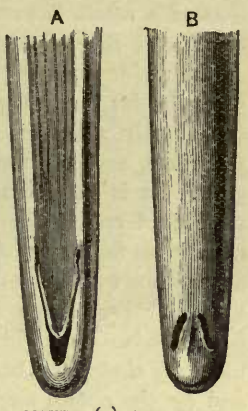
Gerard Krefft says that they are usually found in mountain ranges, and among rocks in the Lower Murray district. He failed to feed them on Ants and their eggs. On hen's eggs they fed for a time, and liked bread-and-milk. He has reason to believe that they live on grass also, as those whose stomachs and intestines he examined had fed on herbs and grasses. The spur on the heel is not used as a weapon of offence.

It inhabits Australia, and has been found as far north as the Bellenden Plains, Queensland, about 18° south latitude. A specimen has also been captured at Cape York, and others at Plain Creek, Queensland. It is not found in Van Diemen's Land.

With regard to the anatomy of the Echidna, it may be said that the long muzzle and the very slender lower jaw give the skull a bird-like look which is increased by the swollen and ball shape of the brain-case. The bones of the skull remain imperfectly united for some time, and

then they are united by plain lines of junction, and not by jagged sutures. The shoulder and the bones of the upper part of the chest resemble those of the Water Mole, and will be noticed in its description. The brain of the Echidna weighs about one-fiftieth of the whole body, and the hemispheres do not conceal the cerebellum. There are three convolutions behind, and in front of them is a large one bent on itself, and on its outside are some oblique folds. The sense of smell, evidently acute in the Echidna, is assisted by a large development of the olfactory lobes of the brain and their nerves.

The Echidnas have large marsupial bones. They have not a true pouch, but only a rudimentary one, or rather an infolding of the skin, during the breeding season, in the female. The orifices of the teats are situated beneath the level of the skin, and inverted; and as the surrounding parts swell under the influence of suckling, there is a little cavity made, at the bottom of which are the so-called nipples. They are really little depressions with hair around them. The young Echidnas are placed in this temporary cavity by the mother, and help themselves by placing their snouts in the small depressions leading to the milk gland. Captain Armit says that some force is required to get the young out of the pouch, and that there is probably a muscular ring to it. They are at first very small. When about a month or so old, the hinder parts of the young may be seen sticking out of the region of the fold, and at three months the body may be observed, the animal still adhering by its snout. When the prickles of the young begin to harden, the old one turns them out into the world. (But see Postscript, p. 234.)



MOUTH (A) AND NOSE-SNOUT (B) OF ECHIDNA.

A short-spined Echidna (*Echidna setosa*) inhabits Van Diemen's Land, whose hair is sufficiently long to hide most of the spines, but little is known regarding its habits. Quoy and Gaimard, two French naturalists, kept one for a month, and it took no food, but after that time it began to lap and to eat a mixture of flour, sugar, and water. It burrowed very rapidly, and got to the bottom of a large can full of earth and plants in the course of a few minutes, and it was assisted in this by its snout.

A species of Echidna has been found in the north of the Island of New Guinea, at the Mont des Karous and Mount Arfak, at an altitude in the first place of 1,150 yards. It likes the rocky broken ground, and is unknown on the sea coast. The natives call it "Nokdiak," and hunt it for the flesh. As the animal burrows well, the natives dig down about a yard in different places, and generally cut across one of the underground runs. It has been described, and has been named after the explorer, M. Brujn. It is more robust and larger than the species from Australia and Van Diemen's Land, has a very long snout—three times the length of the head—a short tail, and is black in colour with white points. The fur is plentiful, and like velvet, whilst the spines are scanty, and about midway in strength between those of the two Australian kinds. The number of nails on the fore and hind feet is singular in this New Guinea Echidna, for there are three on each instead of five. The tongue of the species is longer and more spiny; moreover, the number of vertebræ differs in this new kind. There are seventeen dorsal instead of fifteen, and there is one caudal more than in the others. The spiny pimples on the tongue and palate, so well developed in this Echidna, have tempted Professor Gervais to include it in a new genus, Acanthoglossus; but it is as well to retain the old name, so that the creature is called Echidna Brujnii. Another species has been found in the south of New Guinea, at Port Moresby, which is distinguished chiefly by the long, thin, cylindrical form of the quills, and the stiff, flat, hair-like bristles on the face. The tint of the flattish bristles covering all the body and limbs, except the back, is brown; on the back are long cylindrical spines, some white and others black. There are five claws to each foot, and the second hind toe is said to be the largest. The fore limbs are short, stout, and strong. It has been named Echidna Lawesii (Ramsay), after its discoverer. All these animals can roll themselves up.

THE WATER MOLE, OR DUCK-BILLED PLATYPUS.*

Like most of the other objects of natural history found in Australia and the neighbouring islands, the Water Mole is very singular in its construction, nature, and habits. It is of all animals that

* *Ornithorhynchus anatinus.*

suckle their young the most like a bird, and it really deserves the title, from its external appearance of half beast, half bird. As its shape and method of life are peculiar, it has received several names, such as the Water Mole, the Flat-footed, Duck-billed Platypus, the Bird-beaked quadruped, and the Paradoxical Bird-beaked animal. It is very fond of the water and also of burrowing in the ground, and, of course, is admirably adapted for these pursuits: hence its construction relates to them to a certain extent, and also to that of the animals of which it was, as it were, a continuation in the scheme of nature.

The Ornithorhynchus anatinus has a rather flat body of about eighteen inches in length, and the head and snout greatly resemble those of a Duck, whilst the tail is short, broad, and flat, and resembles that of a small Beaver, but is shorter. The feet are webbed and flat, and the greater part of the creature is covered with a short dense fur of a dusky brown colour, darker on the upper and paler on the under parts of the body. A slight examination of the habits of the animal will explain the necessity for observing it a little more closely. Mr. Bennett describes his first interview with one shortly after his arrival in Australia. He writes: "We soon came to a tranquil part of the river, such as the colonists call a 'pond,' on the surface of which numerous aquatic plants grew. It is in places of this description that the Water Moles are most commonly seen, seeking their food among the aquatic plants, whilst the steep and shaded banks afford them excellent situations for excavating their burrows. We remained stationary on the banks, waiting their appearance with some degree of impatience, and it was not long before my companion quietly directed my attention to one of these animals, paddling on the surface of the water, not far distant from the bank on which we were then standing. In such circumstances they may be readily recognised by their dark bodies, just seen level with the surface, above which the head is slightly raised, and by the circles made in the water round them by their paddling action. On seeing them, the spectator must remain perfectly stationary, as the slightest noise or movement of his body would cause their instant disappearance, so acute are they in sight or hearing, or perhaps both; and they seldom appear when they have been frightened." On ordinary occasions they do not remain more than a minute or two at a time on the surface of the water.

A burrow of an Ornithorhynchus, which Mr. Bennett opened, had its entrance on a steep part of a bank, situated about one foot from the water's edge, and concealed among the long grass and other plants. "This burrow ran up the bank in a serpentine course, approaching nearer to the surface of the earth towards its termination, at which part the nest is situated. No nest had yet been made in the termination of the burrow, for that appears to be formed about the time of bringing forth the young, and consists merely of dried grass, weeds, &c., strewed over the floor of this part of the habitation." The expanded termination measured one foot in length and six inches in breadth, and the whole length of the burrow was twenty feet. Besides the entrance before alluded to, it appears there is usually a second opening into the burrows below the surface of the water, communicating with the interior, just within the upper aperture. A burrow subsequently examined by Mr. Bennett terminated at a distance of thirty-five feet from the entrance; and that gentleman stated that they have been found fifty feet in length.

From the burrow first opened by Mr. Bennett a living female was taken, and placed in a cask, with grass, mud, water, &c., and in this situation it soon became tranquil, and apparently reconciled to its confinement. On his return home to Sydney, Mr. Bennett determined to indulge it with a bathe; and with this view, when he arrived in the vicinity of some ponds, he tied a long cord to its leg. "When placed on the bank, it soon found its way into the water, and travelled up the stream, apparently delighting in those places which most abounded in aquatic weeds. When diving in deep and clear water, its motions were distinctly seen: it sank speedily to the bottom, swam there for a short distance, and then rose again to the surface. It appeared, however, to prefer keeping close to the bank, occasionally thrusting its beak into the mud, from whence it evidently procured food, as, on raising the head, after withdrawing the beak, the mandibles were seen in lateral motion, as is usual when the animal masticates. The motions of the mandibles were similar to those of a Duck under the same circumstances. After feeding, it would lie sometimes on the grassy bank, and at others partly in and partly out of the water, combing and cleaning its coat with the claws of the hind feet. This process occupied a considerable time, and greatly improved its sleek and glossy appearance."

The Water Moles are said to have a peculiarly fishy smell, more especially when wet, which probably proceeds from an oily secretion. They are used by the aborigines for food; "but it is no particular recommendation of them," Mr. Bennett remarks, "to say they are eaten by the native Australian, as nothing in the shape of provender comes amiss to him, whether it be Snakes, Rats, Frogs, Grubs, or the more delicate Opossum, Bandicoot, and Flying Squirrel."

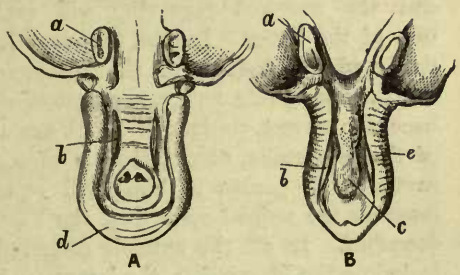
The Ornithorhynchus is captured by the natives when in its burrow. They first examine the neighbourhood of the burrow, to ascertain, by the presence of recent footmarks on the soil, whether it is inhabited, and if the examination proves satisfactory, they proceed to dig holes with pieces of sticks from the surface of the ground into the burrow, at distances from each other, until they discover its termination, when the Australians consider themselves exceedingly fortunate should they find the young, since they are regarded as a great delicacy.

The young have been found in their nests by Mr. Bennett about one inch and seven-eighths in length, in the early part of December, and near the end of the same month he found young Water Moles of ten inches in length. These latter were kept alive for nearly five weeks, and their habits whilst in captivity are described in detail in his paper, which is illustrated by some admirable figures, showing their various attitudes, &c. The young were allowed to run about the room; but an old Ornithorhynchus in the possession of our author was so restless, and damaged the walls of the room so much by her attempts at burrowing, that it was found necessary to confine her to the box. "During the day she would remain quiet, huddled up with her young ones; but at night she became very restless, and eager to escape. The little ones were as frolicsome as puppies, and apparently as fond of play; and many of their actions were not a little ludicrous. During the day they seemed to prefer a dark corner for repose, and generally resorted to the spot to which they had been accustomed, although they would change it on a sudden, apparently from mere caprice. They did not appear to like deep water, but enjoyed exceedingly a bathe in shallow water, with a turf of grass placed in one corner of the pan; they seldom remained longer than ten or fifteen minutes in the water at one time. Though apparently nocturnal, or at least preferring the cool and dusky evening to the glare and heat of noon, their movements in this respect were so irregular as to furnish no grounds for a definite conclusion. They slept much; and it frequently happened that one slept whilst the other was running about; and this occurred at almost all periods of the day. They climbed with great readiness to the summit of a book-case, and thus, by means of their strong cutaneous muscles and of their claws, mounting with much expedition to the top. Their food consisted of bread soaked in water, chopped eggs, and meat minced very small, and they did not seem to prefer milk to water."

Mr. Foulerton states that the natives are seldom successful in catching the Water Moles alive, although in some places in the rivers and creeks of New England they are so numerous that from fifteen to eighteen have been shot in an afternoon. In the dark, rocky, shady rivers they may be seen at any time of the day, but in more open places seldom before sunset. He failed to see any young ones, and believes that they keep them concealed until near their maturity. They are very active in the water, and are more frequently under than above the surface. He never saw one leave the water, and states that they made very poor progress on land. As a rule they are to be found in good fellowship with the Australian Water Rat (*Hydromys chrysogaster*).

The young Water Moles are naked, and have a short beak with fleshy and smooth edges, and this conformation enables them to seize the space on the mother whence the milk comes, for there are no nipples. Their tongue is large and assists in the sucking also.

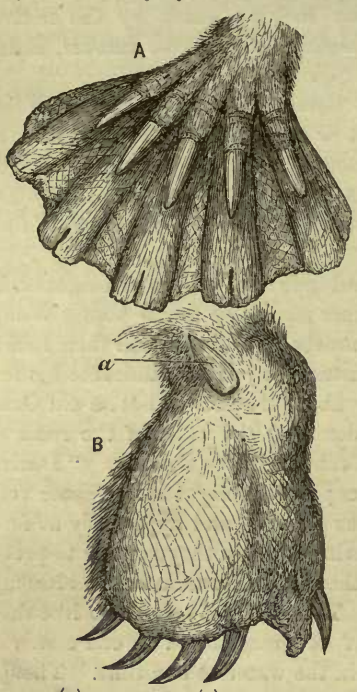
The most curious feature in the Ornithorhynchus is the snout in the form of a beak. This is flat and broadest in front where it is rounded. It is hard, and is covered with a skin full of pores, and on each side this skin overlaps the sides to form a kind of fringe or flexible cheek, and this free membrane is carried round the front. Where this skin comes to the head, it forms a wide fold, which flaps over the front of the head and throat, and is a capital protection



JAWS OF THE DUCK-BILLED PLATYPUS.
(*After Waterhouse.*)

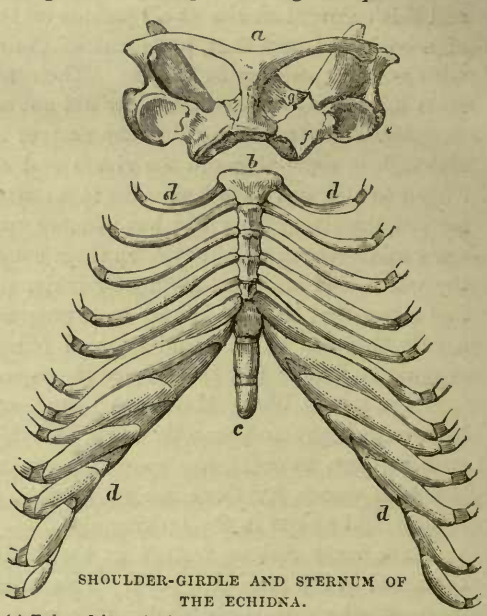
(A) Upper, (B) Lower Jaw; (*a*) Molar Teeth; (*b*) Narrow Anterior Teeth; (*c*) Tongue; (*d*) Integument projecting from Jaw; (*e*) Transverse Ridges on Covering of Beak.

when the creature is grubbing in the wet banks or burrowing, and evidently protects the face and the eyes from injury. The nostrils are close to the extremity of the snout. In the lower jaw, or part of the beak-like snout, there are some ridges, which mark it cross-wise from the mouth to the outside, and corresponding structures may be noticed in a Duck, their use being to provide grooves or spaces through which water may pour out of the mouth when the creature is feeding on soft mud and wet substances. Inside the mouth there is a pouch in the cheek, one on each side, and this is to retain food. It has four teeth in the upper and four in the lower jaw, but they are horny and made up of tubes; the front ones are long and narrow, and the others are oblong and oval in form, with a hollow crown. Moreover, the tongue, as in some reptiles, has horny teeth on it. The eyes of the creature are small and brown, and are situated close to the beak, and they look upwards. The ear is hidden by the fur, but it is none the less sharp of hearing. As may be gleaned from the notice of its habits, the animal has great power of swimming but not much of running, although the limbs are short. The fore-feet have five toes, nearly equal in length, the first being rather the shortest, and all have solid and rounded claws. The toes are webbed, and the fold of skin even extends in front of the claws when swimming is going on, but is folded back in digging. In the hind-feet the web does not extend farther than the base of the claws, and there is a spur on the heel, which is movable and sharp. It is found on the adult males in perfection, and it may be useful as well as ornamental. On carefully examining the under and lower part of the body, the milk or mammary glands are to be seen, and there is no proper nipple; but when suckling, the swelling of the gland produces an eminence, which can be grasped by the wide, open, and soft beak of the young.



FORE (A) AND HIND (B) FOOT OF THE DUCK-BILLED PLATYPUS.
(*After Waterhouse.*)
(*a*) Spur on Heel of Hind Foot.

It was thought that this bird-like creature laid eggs, but the point was not easy to determine. (See Postscript, page 234.) It has a double uterus, leading to the common canal, called urogenital, and this ends in the common outlet. The Ornithorhynchus and Echidna have an arrangement of the bones of the shoulder and chest, which resembles to a certain extent that of the Lizards and of the Ichthyosaurus, and the annexed engraving will explain the position of the bones. Indeed, the most important peculiarity in the skeleton of the Monotremes is that of the shoulder-girdle and upper part of the chest; for a bone, the merest vestiges of which are noticed in some of the Mammalia, occurs, that is of some importance in the great groups of birds and reptiles, which are lower in the animal scale than the Vertebrata already described. In all the animals described hitherto, and including the Marsupiata, the large arm bone (humerus) is jointed at the shoulder with the blade bone, or scapula. The socket in this bone, which receives the somewhat ball-shaped top of the humerus, in order to permit of very general motion, is a part of the scapula, and is called the glenoid cavity; but in the Monotremes a bone called the coracoid joins with the scapula, and forms part of the socket;



SHOULDER-GIRDLE AND STERNUM OF THE ECHIDNA.
(*a*) T-shaped interclavicle; (*b*) Manubrium; (*c*) Ensiform end of sternum; (*d*) Cartilages of ribs; (*e*) Scapula; (*f*) Coracoid; (*g*) Epicoracoid.

moreover, this coracoid is long enough to reach the breast bone, or sternum. The breast bone in the Mammalia hitherto noticed consists of an expanded part at its fore end (in the usual position of quadrupeds), or at its top in man, called the manubrium, and of some smaller pieces, which form the front bone of the chest and reach to the belly, having ribs attached to them on each side. This is the state of things in the Monotremes; and the coracoids are attached to the manubrium, one on each

DUCK-BILLED PLATYPUS.

side. In other Mammalia it is the collar bone which is jointed there. In addition to these breast bones in the Monotremes, there are other bones in front, or between the neck and the top of the manubrium. Firstly, there is a bone in the shape of a T: the lower point is on the breast bone, and the cross-bar supports a collar bone on each side, which reaches outwards to the blade bone. Secondly, there is a bone on each side in front of the coracoid, reaching forwards towards the neck. This is called the epicoracoid. Some of these bones, now noticed for the first time, are more or less common to birds, reptiles, and amphibians.

There are some other anatomical points which ally the Monotremes to the reptiles. For instance, the peg on the second, or axis vertebra of the neck, is not fixed to the bone by true bony matter, and some of the ribs which exist in the neck in the Monotremes are separate from the vertebræ until late

in life, or altogether. And the cavity for jointing of the thigh bone with the pelvis (the acetabulum) is not perfect, there being a part of it not filled with bony matter.

The ear is singularly simple in its construction in this sub-order, and the cochlea is not coiled into a spiral; moreover, there is no external ear.

The hemispheres of the brain, which are convoluted in the Echidnas, are smooth in the Ornithorhynchus, and in both the central commissure, or corpus callosum, just exists, whilst the anterior one is large. The Ornithorhynchus inhabits Van Diemen's Land and Australia, as far north as Queensland inclusive.

The Echidna and the Ornithorhynchus belong to a sub-order of the Marsupialia which, whilst it has some structures resembling those of the sub-order of Marsupiata, possesses others which link it with the birds and reptiles. This sub-order is the lowest amongst the Mammalia, and the animals which are included in it have the following peculiarities:—The marsupial bones are present, the uterus is double, and the young are not nourished when within the parent by a placenta; there is no inflection of the lower jaw; the shoulder-girdle has additional bones; there are no true nipples; the teeth are either absent or horny; the external ear is not present, and there is not a true pouch. The excretion of the kidneys and the contents of the bowels fall into one receptacle, through which the young also pass. It is called a cloaca, and receives the outlets of the rectum and urogenital canal. The presence of the spur on the heel is also a peculiarity.

A fossil Echidna has been discovered in deposits on the Darling Downs.

The Echidnas form one genus and the Ornithorhynchus another, and the classification of the whole is as follows:—

Order	Marsupialia.
Sub-Order . . .	Monotremata.
Genus	Echidna.
Genus	Ornithorhynchus.

In concluding this Natural History of the Marsupiata and Monotremata, it is necessary to direct attention to the fact that they are less well defined than the other great groups of the Mammalia. As sub-orders, they are very artificial, for some of their most important structural peculiarities are deficient in some of the genera. The inflected lower jaw is not invariably found, the marsupium does not always exist, and the marsupial bones differ in shape and size, and are occasionally absent. With regard to these bones or cartilages, they are not connected with the pouch, but with the muscular system of the belly. They have been shown by Huxley to be present in Crocodiles, and in the amphibian called the Salamander. Hence these structures are relics of a remote ancestry, and have but slight functional importance. The authorities whence I have derived most of this Natural History are Waterhouse, Owen, Huxley, Bennett, Gould, and Kreeft, to whom I am under great obligations.

P. Martin Duncan.

Postscript.—Mr. W. H. Caldwell has discovered that the Monotremes lay eggs as has been suspected, and he has traced the development of the animal during the hatching. The eggs resemble those of a Reptile more than a Mammal, and the yolk is in such excess that it is not all subdivided during the early stages of the embryo of the Monotreme, but some remains over and above, upon which it is nourished in the early stages within the egg. The heart of Ornithorhynchus paradoxus is interesting because Meckel, and, subsequently, Prof. E. Ray Lankester, F.R.S., have shown that it differs from that of the higher Mammalia, and is not without considerable resemblance in some of the valvular structures to the hearts of Birds and Crocodiles. The last-named naturalist states that the reflux of blood into the right auricle on contraction of the ventricle, is not prevented by the presence of the special structure seen in Mammals, but by an arrangement which is observed in Reptiles and Birds. The mitral valve is with three divisions instead of two, as in the higher Mammalia, but the tendinous structures seen in this last group, to terminate the muscular structures, do not exist in the Monotreme. This increase of the muscular structure is not so palpable in Echidna. It is interesting to know that the special structures of the right side of the heart in the adult Ornithorhynchus are seen in the embryonic condition of the higher Mammalia.

IMPERIAL EAGLE.

THE CLASS AVES.—THE BIRDS.

CHAPTER I.

INTRODUCTION—WING-STRUCTURE AND FEATHERS—DISTRIBUTION.

Introduction—Distinctive Characters of the Class Aves—Power of Flight—The Wing—Its Structure—The Six Zoo-geographical Regions of the Earth—Birds peculiar to these Regions.

THE study of birds is almost an instinct in an Englishman: from peasant to noble, an innate affection for the feathered songsters seems to prevail; so that whether it be in a stately aviary or in a little cage outside a cottage door, birds are found to be the constant companions of man throughout the length and breadth of the land. And it is possible that no other country in the world possesses such a number of birds, in proportion to its size, as does Great Britain. Any one travelling on the continent of Europe cannot fail to notice how few birds meet his eye; and although they may be there, and may be found by a little searching for, they do not form such a prominent feature of a walk as they do in England or Scotland. Even the toiler in large towns has but to get a little way into the nearest fields to hear the cheering song of the Skylark or the Thrush, or to be amused with the bustling and active habits of the Starling, or those of the more sedate and cautious Rook. It is certain that a study of the habits of birds will always repay the student, who may see in the feathered favourites which are around him many a little bright example

to be followed, if he read the lesson aright. Birds teach us many things—perseverance, fidelity, parental affection, thrift, cleanliness, and many other domestic virtues, which are to be seen carried out in their life in the greatest perfection. In the following pages the birds will be passed in review, and the habits of some of the most striking and important forms will be detailed. But, although every species and genus cannot be noticed here, it is necessary to assure the student that in every country—even in England, where so much has been done for Ornithology—he will find an ample reward in the study of all birds; and that even the commonest species cannot be neglected, for there is always something new to learn and to record in their life-history. To quote Dr. A. E. Brehm, one of the most accomplished observers of nature, who, carefully trained by his father, a true naturalist also, has studied the feathered tribes in many climes :—

"He who is only half at home with nature on this earth of ours will be able to approximately to appreciate the feelings with which the naturalist wanders and travels from place to place : wherever he may be he finds friendly forms. For years he has silently watched the interior economy and household arrangements of animated nature, and yet he has not seen all; and on this account he is never in want of employment. Every bird is a personal friend : the old ones he knows almost as well as he knows himself, and the new ones must be studied. How much more is there yet to observe ! Rich as he may be in experiences, every fresh ramble brings him fresh mental treasure. The relations existing between him and the bird become each day more and more intimate; he knows the lives and habits of each : when each arrives, or takes its departure : where is its abode : how it is made : when it is occupied by a happy troop of nestlings : when deserted. The naturalist knows his friends by their notes, flight, and bearing. In his eye the bird never ceases to exist : alive or dead it is always interesting in his eyes, for in either case the bird is associated with a poesy of feeling in creative nature which he would put into words. Every new bird raises his spirits a step higher; every fresh discovery is a step onward in the knowledge of the ways and means of all things. He is indebted to his friends for many a happy hour; their lives are a pattern worthy of imitation."*

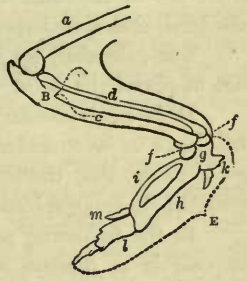
Here, then, we may ask—What is a bird? How can a bird be told from all other Vertebrate animals? The chief character which distinguishes the class of birds is undoubtedly *the clothing of the body with feathers*. Other characters they also possess, but not exclusively. For instance, they have the power of flight developed in the greatest degree : but there are some birds, such as the Apteryx, the Ostrich, and the Cassowary, which cannot fly at all; while, on the other hand, there are flying mammals, such as Bats, Flying Squirrels, and there are flying reptiles, which can progress through the air by means of flight. Again, birds lay the eggs from which they produce their young; but so do many reptiles and fish : so that this cannot be considered a prerogative of the class of birds. Their bill is hard and sheathed in horn; but so is that of the Duck-billed Platypus (page 231), an animal belonging to the Monotreme Mammals; and Turtles also have beaks. Most, but not all, birds build nests; and in this they stand almost alone among the higher animals; but nest-building propensities are developed in many of the Mammalia—in the Lemurs and Mice, for instance—while it cannot be assigned as a habit peculiar to birds, as the wonderful nests made by some fish conclusively prove.

All birds, whether they fly or not, are clothed with feathers, and this distinguishes the class *Aves* in the existing state of nature. The majority are specially adapted for flight : and as this is undoubtedly the most vigorous form of locomotion, the greatest muscular efforts being required to raise and sustain a body above the ground and to propel it rapidly through the air, a large development of muscular energy is necessary. The great strain on the circulation of the blood is met by a heart not only as complete as in the Mammalia, but with stronger and a peculiar valvular mechanism for propelling that fluid vigorously through the body. Moreover, in addition to their lungs, birds possess a singular provision of air-receptacles within the body, and these are connected with a series of cavities, also filled with air, which occupy the interior of most of the bones. These cavities serve not only to give lightness to the bird's body, but they also assist the lungs in aërating the blood, so that birds may be said to enjoy a double respiration. As birds exceed mammals in the activity of their breathing and circulatory system, so also they possess a higher degree of animal heat, their temperature ranging from 106° to 112° Fahr. This high temperature, which exceeds

* Dr. Brehm : "Bird-life," pp. 503, 504.

that of the Mammalia by from 8° to 14°, is maintained by its admirable feather-clothing, which, being a non-conductor, effectually serves to guard against any sudden variations of temperature in the air to which its body is exposed, during its rapid and extensive flights, as well as tempering the usual radiation from the body.

As one might expect in the fore-limb of a creature specially organised for suspension in, and progression through, the air, it is found that the muscles, as well as the bones and joints, of the bird's wing become much modified as compared with the corresponding parts of other animals. With all our scientific knowledge and mechanical contrivances, no one has yet succeeded in constructing a flying machine. It is a significant fact that Nature has not only long ago solved this problem, but that she has done so in several ways. The flight of an insect, of a bird, of a bat, is equally perfect in its way: but in each case the result is attained by very different modifications in the skeletal and muscular apparatus. The principal resistance that a flying animal has to work against is its weight: that is, the force of gravity which, proportionately to its mass, tends to draw it down vertically towards the earth; hence the muscles which are largest and strongest in a bird are those which pull down the wing against the air, thereby raising the body and overcoming its weight.

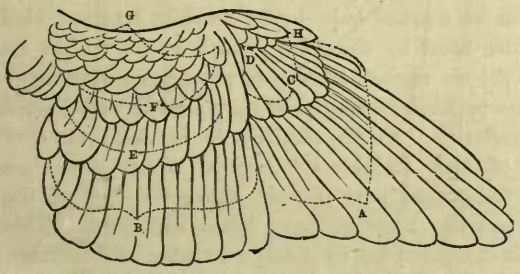


BONES OF WING OF BIRD. (*After Sundevall.*)

(*a*) Humerus; (B) Cubitus; (*c*) Ulna; (*d*) Radius; (E) Manus, or hand; (*f*) Carpus; (*g*, *h*, *i*) Metacarpus; (*k*) Pollex, or thumb; (*l*) Second digit; (*m*) Third digit.

The chief muscle thus employed is the "great pectoral," attached to the large keel (or ridge) on the breast-bone, and inserted into the "humerus," or "arm-bone." This "great pectoral" is generally the largest muscle in the bird's body, and in fact often equals in bulk all the other muscles put together.

The wing is *opened out* by straightening the elbow and the wrist-joints. The former process is effected by the contraction of the *triceps;* the latter chiefly by the action of the so-called "radial extensors," and by the elasticity of the long "tensor," or ligament, which comes from the shoulder muscles along the front border of the anterior wing-membrane, and is attached to the base of the thumb, at the front side of the wrist.



FEATHERS OF WING OF BIRD. (*After Sundevall.*)

(A) Feathers of the *manus*, or primary quills; (B) Feathers of the *cubitus*, or secondary quills; (C) Coverts of the *manus*, or primary-coverts; (D) Lesser primary-coverts; (E) Coverts of the *cubitus*, or secondary-coverts; (F) Median coverts; (G) Lesser coverts; (H) Feathers of the thumb, or bastard wing.

The wing is *folded* by the bending of the elbow and the adduction of the wrist-joints. The elbow is bent principally by the contraction of the "biceps" and the "internal brachial," the wrist-joint chiefly by the contraction of the "hand-adductor," and of the "ulnar wrist-flexor."

As already stated, the possession of feathers is one of the most characteristic features in a bird. These beautiful structures are modifications of the skin, just as are the scales of the feet and the claws of the toes. Feathers and hairs, scales and claws, are all produced out of, and are modifications of, the cells of the upper skin, or *epidermis*, and of the under, or true skin, or *cutis*. The feathers differ much in their minute construction in some birds; and all those of a bird are of course not of the same size and shape, but they have the following parts in common.

A feather consists of a quill, a shaft, barbs, and barbules: moreover, there may be a kind of accessory part, often in the shape of a downy tuft, close to the junction of the shaft and the quill. The shaft (*scapus*) or axis of every perfect feather (*penna*) is divided into the quill (*calamus*), the hollow cylinder (*d*), which is partly embedded in a sac of the skin, and the true shaft (*rachis*, *a*), which bears on each side the lateral processes called barbs (*rami* or *radii*). The rachis and the barbs together are known as the vane (*vexillum*), and, in fact, form what is commonly known as the "feather" in contradistinction to the "quill." The barbs (*c*, *c*, *c*, *c*) are narrow plates, or laminæ, "tapering to points at their free ends, and attached by their bases on each side of the rachis. The edges of these barbs are directed upwards and downwards, when the *vexillum* of the feather is horizontal

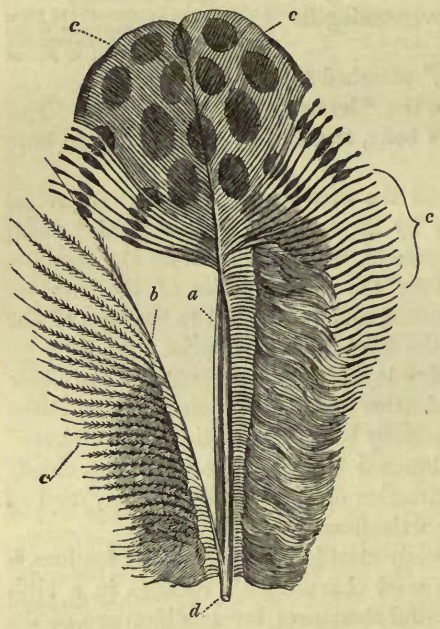
The interstices between the barbs are filled up by the *barbules*, pointed processes, which stand in the same relation to the barbs as the barbs do to the rachis. The barbules themselves may be laterally serrated and terminated by little hooks, which interlock with the hooks of the opposed barbules. In very many birds each quill bears two *vexilla;* the second, called the *aftershaft* (*b*) (*hyporachis*), being attached on the under side of the first,"* close to the junction of the shaft with the quills.

In all the feathers of the Ratitæ, and in the case of all but the contour feathers in other birds, there are no barbules to the barbs. The pennæ are ordinarily arranged in definite patches, or areas on the bird, and the shape and size of these, and their relation to one another, differ in many birds.

The *aftershaft* (*b*) is ordinarily a smaller *vexillum*, which is attached to the under side of the larger one at about the point where the rounded quill passes into the stem.

It is not necessary to notice these important characteristic structures more fully now, as they will have to be considered in explaining the distinctions between the great groups of birds, and we pass on to notice that the same kinds of birds are not found everywhere, but that they have, as groups, a remarkable geographical distribution.

In the following pages the distribution of birds is often alluded to, although it will naturally be impossible to discuss, within these limits, all the various phases of the study which the geographical distribution of the feathered tribes opens up to us. At the same time sufficient evidence will be given to show that birds are not scattered without order over the earth, but are more or less restricted to certain spots.



PARTS OF A FEATHER. (*After Nitzsch.*)

The six natural history or distributional provinces into which the world is ordinarily divided by modern naturalists were determined, first of all, from the study of the birds; and in fixing the boundaries of each division the wading birds and many swimming birds must be left out of the question, as they are creatures of such very extensive flight, and wander almost from pole to pole. A natural region, therefore, can be marked only by its resident forms of bird life, or at the most by the birds which breed within its limits; and the six regions alluded to provide us with many excellent reasons for believing that they possess well-defined physical boundaries. No Capercailzie, for instance, was ever found out of the *Palæarctic*† region, which comprises Europe and the greater part of Asia above the line of the Himalayas and the Yangtze-kiang River in China. This region is also characterised by a large number of Buntings, Warblers, Grouse, &c. In the *Nearctic*‡ region there is a certain similarity to the European and Siberian Avifauna, Grouse, Ptarmigan, Waxwings, Magpies, Ravens, &c., being commonly found throughout the two regions. North America possesses, however, several forms peculiar to itself, though it is by no means so rich in species as is the *Neotropical*§ region, which commences south of a line drawn through Northern Mexico, and includes the whole of Central and Southern America. Within this large area are contained whole families of birds, such as Toucans, Mot-mots, the vast majority of the Humming-birds, Trogons, besides innumerable genera of Tanagers and other forms, so that this region is by far the richest in the world as regards bird life. The *Ethiopian* region embraces all Africa below the Sahara Desert and Madagascar: Plaintain-eaters, &c., are characteristic of this region. The *Indian* region skirts the Palæarctic, and includes the remainder of Asia below the Himalayas and the Yangtze-kiang; the Malayan Peninsula, the Sunda Islands, and the Philippines, belong to this region, which contains all the

* Huxley, "Anatomy of Vertebrates," p. 274.

† παλαιός, old; ἄρκτος, north: *i.e.*, the northern division of the *Old* World.

‡ νέος, new; ἄρκτος, north: *i.e.*, the northern division of the *New* World.

§ νέος, new; τροπικός, tropical: *i.e.*, the tropical division of the *New* World.

finest Pheasants in the world, the Impeyan Pheasant from the Himalayas, the Tragopans, and the Lobed Pheasant of Borneo being most beautiful creatures. Lastly, between the islands of Bali and Lombok passes a deep sea boundary called "Wallace's line," which divides the *Australian* region from the Indian, and although these islands lie so close together, the great depth of the channel between them seems to mark them out as frontier lines of two ancient continents. Certain it is that the birds and animals on each side of Wallace's line differ remarkably; and the Australian region, which includes all the Moluccas, New Guinea, and Oceania, in addition to the Australian continent and New Zealand, presents us with forms not found elsewhere, such as Birds of Paradise, Cassowaries, Lyre-birds, and a large variety of peculiar types. Many smaller divisions of the globe are now recognised, but the above are the main ones, which may occasionally be referred to in these pages.*

Many birds migrate, and the student of migration alone would find sufficient material there for the work of a lifetime; and it seems almost impossible to account for the instinct or other causes which bring birds regularly year by year to breed in the same haunts, and which drive them away at the same change of season. Why is it, for instance, that species of similar habits and form, and both visiting Europe in equal abundance, should occupy such different winter quarters? Yet the common Red-backed Shrike, or Butcher-bird (*Lanius collyrio*), when he is said to leave Europe, passes by the Nile Valley along the east coast of Africa down to the Cape, where he brings up a second brood of nestlings; while the Wood-Chat Shrike (*Lanius auriculatus*), a bird of about the same size and of precisely similar habits, proceeds down the Nile Valley and invades Abyssinia in the winter, and also occupies Senegambia, where a Red-backed Shrike has never been found yet by a naturalist. Nothing whatever is known by which route the bird gets to the Gambia: whether he follows the same one as his red-backed relation as far as Abyssinia, and then skirts the southern edge of the Sahara, or whether he reaches north-western Africa by a direct flight across the Great Desert. Many other such problems in the economy of our most familiar species are still awaiting further scientific research.

CHAPTER II.

THE ANATOMY OF A BIRD.†

The Three Divisions of the Class Aves—Anatomy of a Bird—The Skeleton—Distinctive Features—Peculiar Bone Character—The Skull—Difference between the Skull of Birds and that of Mammals—The Jawbones—Vertebral Column—Sternum—Fore limbs—Hind limbs—Toes—The Muscular System—How a Bird remains Fixed when Asleep—The Oil-gland—The Nervous System—The Brain—The Eye—The Ear—The Digestive System—The Dental papillæ—The Beak—Tongue—Gullet—Crop—Stomach—Uses of the Gizzard—Intestine—The Liver, Pancreas, and Spleen—The Blood and Circulatory System—Temperature of Blood of a Bird—Blood Corpuscles—The Heart—The Respiratory System—Lungs—Air-sacs—The Organs of Voice—The Egg—Classification of the Class Aves.

Birds may be separated into three great divisions: the *Carinatæ*, or birds with a keeled sternum, the *Ratitæ*, or birds having a raft-like sternum, and the *Saururæ*, or lizard-like birds. The last of these orders links the birds with the reptiles, and does not concern us here, as it contains only one genus, and that a fossil one, the *Archæopteryx lithographica*, respecting which a few words will be found at the end of this article (Vol. IV., pp. 236–8). The other two divisions are of great importance, and are easily recognisable, although the characters which separate them are chiefly anatomical. The principal point of difference lies in the sternum, or breast-bone, and the name *Carinatæ* is given to all those which have a keel (*carina*) or sternal ridge largely developed, as in the common fowl; and this is present in the great majority of birds. The *Ratitæ* have not got this keel, and in this division are found the Struthious birds—Ostriches, Cassowaries, &c. They are all species which cannot fly; and although the number at present existing is small, the fact of their being found

* Dr. Sclater, F.R.S., originated, in 1858, this scheme of the six zoogeographical divisions of the globe.

† In the preparation of this chapter, the author begs to acknowledge the assistance he has received from his friend Professor F. Jeffrey Bell, B.A.

at widely distant parts of the earth—in South America, in Africa, and again in Australia—would seem to indicate that they were once more plentifully distributed, and that they are remains of what was formerly a large and important group. To these Ratite birds belonged also the extinct gigantic Moas of New Zealand, and the *Æpyornis* of Madagascar.

Before proceeding further, it will be necessary to give a brief outline of the principal anatomical features of a bird's body. On examining either the general features of the skeleton, or the minute characters of many of the bones of which it is made up, in such a bird as a Hawk, for example, we are arrested by those remarkable arrangements by which this part of the body is adapted to the mode of life of its possessor. Here, however, as in so many instances, we have to distinguish between what is characteristic of the bird as a flying animal, and what is more or less common to it and other vertebrate animals, and does not especially relate to peculiar habits. We may well be struck by the marvellous power which birds have, and which man has not, and it is curious to notice how man's aspirations have ever been associated with it. Without pausing to observe that painters always endow spirits with wings, or that the imaginative genius of the French has emboldened them to form a "Société d'Encouragement pour la Locomotion Aérienne," we may find in the words of Faust definite expression of what man feels with regard to the law by which he is held down to earth :—

"Ich eile fort, ihr ew'ges Licht zu trinken,
Vor mir den Tag und hinter mir die Nacht,
Den Himmel über mir, und unter mir die Wellen.
Ein schöner Traum, indessen sie entweicht.
Ach! zu des Geistes Flügeln wird so leicht
Kein körperlicher Flügel sich gesellen.
Doch ist es jedem eingeboren,
Dass sein Gefühl hinauf und vorwärts dringt,
Wenn über uns, im blauen Raum verloren,
Ihr schmetternd Lied die Lerche singt,
Wenn über schroffen Fichtenhöhen
Der Adler ausgebreitet schwebt,
Und über Flächen, über Seen
Der Kranich nach der Heimat strebt."*

Inspired by feelings such as those so powerfully expressed in Goethe's lines, numerous naturalists have treated of the bird as though the powers of flight were confined to it, and were not shared by Bees and Bats in the present, and by Pterodactyles in the past. With this word of comment, which it is even still necessary to insist upon, attention should be given to the following avian characters :—The anterior limbs do not touch the ground, and the bones which compose them are adapted for carrying the feathers of the wing; the breast-bone is not only elongated, but has its central portion developed (except in the Ratitæ) into a strong keel, the better to permit insertion of the muscles by which the fore-limb is moved; the small bones (vertebræ) in the region of the back are fixed firmly together, and are not, as in man or in the Ostrich, movable on one another; while those which succeed them are often welded into one mass with the greatly-developed upper bones (*ilia*) of the pelvic girdle; and the hinder vertebræ develop an upstanding plate (ploughshare bone) which gives support to the *rectrices*, or so-called steering feathers of the tail. It will have been seen that the ordinary seizing organ of man (the hand) has in birds been modified to serve another purpose; but this is made up for, not only by the character of the beak, but by the long and flexible neck, and in some by the grasping toes.

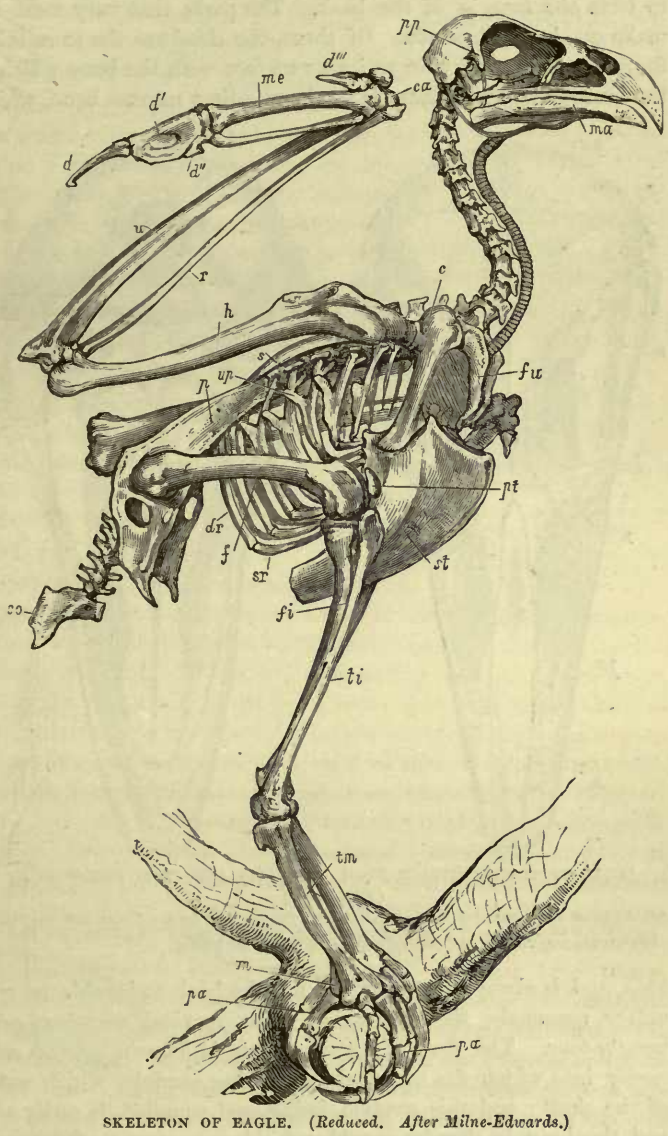
Before describing in detail the characters of the different parts of the skeleton, it is to be noted that many of the bones are not, as in the Mammalia, filled with marrow, but with air; a large cavity may, for example, be seen in the upper bone (*humerus*) of the wing of the common fowl. It is obvious that the specific gravity, or weight of the bird, is thus largely reduced, while the connection between

* These lines are thus translated by Mr. Hayward :—"I hurry on to drink his everlasting light—the day before me and the night behind—the heavens above, and under me the waves. A glorious dream! as it is passing, he is gone. Alas! no bodily wing will so easily keep pace with the wings of the mind! Yet it is the inborn tendency of our being for feeling to strive upwards and onwards; when, over us, lost in the blue expanse the lark sings its thrilling lay; when, over rugged pine-covered heights, the out-spread eagle soars; and, over marsh and sea, the crane struggles onward to her home."

these air-spaces and those which are derived from the lungs enables the contained air to undergo the necessary exchanges with the surrounding medium.

It was long ago observed by the famous German anatomist, Johannes Müller, that "it has often been a subject for complaint that the anatomical characters of birds are so constant that they are of but slight assistance in the labours of the zoologist." The truth of this will very forcibly strike any one who comes to the study of the skulls of birds, after having examined a series of skulls in mammals, so that the seemingly trivial variations to which anatomists have directed attention are in truth those which are, in birds, often of the most importance.

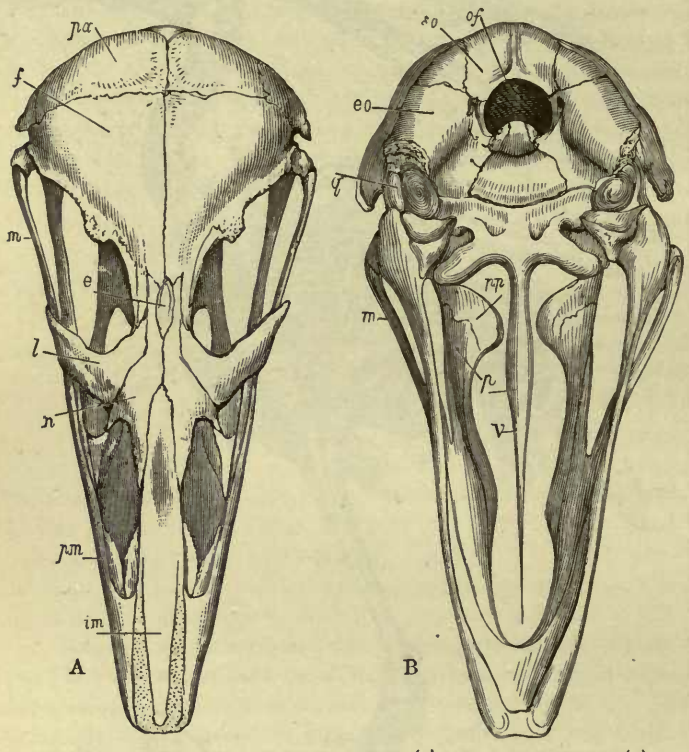
The skull, then, is, as compared with the rest of the body, small; but that portion which contains the brain is relatively larger to the face than it is in any living mammal. The orbits, or cavities in which lie the eyes, are very deep, in consequence of the small extent to which the walls of the brain-case extend forwards. The cavities of each side are separated by a partition (*inter-orbital septum*), which is more or less bony; the nasal bones are short, so that the nasal orifices (anterior *nares*) are placed near to where the beak joins the face. Of the four bones which bound the great opening at the back of the skull for the passage of the spinal cord, three take part in the formation of the single ball-like projection, or condyle, by which the skull is hinged on the vertebral column. In this point, the skull of birds offers a striking point of dissimilarity to that of mammals, in which there are two condyles, one on each side of the great opening (*of*). Another point in which birds do not resemble mammals is in the mode by which the lower jaw is hinged on the skull. This is in the case of birds effected by a bone, which, being more or less square in shape, has gained the name of the *quadrate* (*q*). In mammals the skull proper and the lower jaw are directly connected. This quadrate bone is connected by a long narrow bar (*quadrato-jugal*) with the bones which go to form the "beak," and also, by a narrow bone directed inwards, with the bones which lie in the middle line of the base of the skull, and form the hard palate. The connections between these bones are often of such a kind as to allow of the upper jaw, or upper half of the beak, being movable on the rest of the skull, the upper bones of which are so completely united together as to form a very firm point of support. In the Parrots this arrangement is carried to an extreme, for the slender bones (nasals and processes of the pre-maxillaries) which connect the upper jaw with the



SKELETON OF EAGLE. (*Reduced. After Milne-Edwards.*)

(*p*) Pelvis; (*c*) Coracoid; (*dr*) Dorsal ribs; (*sr*) Sternal ribs; (*up*) Uncinate processes; (*co*) Coccyx; (*r*) Radius; (*u*) Ulna; (*d*) first phalanx of chief digit of the wing; (*d'*) second phalanx of chief digit of the wing; (*d''*) Phalanges of lower digit; (*d'''*) Pollex; (*ca*) Carpus; (*f*) Femur; (*fu*) Furcula; (*h*) Humerus; (*pp*) Postorbital process; (*tm*) Tarso-metatarsus; (*m*) Metatarsus; (*ma*) Lower jaw; (*me*) Metacarpus; (*s*) Scapula; (*pa*) Phalanges of foot; (*fi*) Fibula; (*pt*) Patella; (*st*) Sternum; (*ti*) Tibia.

bones of the brain-case form with them a distinct joint, and so allow of that large amount of vertical movement which will have been observed in these birds. The pre-maxillary bones (*pm*), which are so small in mammals, are very largely developed in birds, giving off, as they do, three processes: one to the *frontal bone* (or fore-bone of the brain-case), one along the hard palate, and another externally to form the margin of the beak. The parts that vary most in this bone-group are the bones which make up the hard palate. Of these, the chief are the so-called *palatines* (*p*) and the *maxillaries;* the former are united by an articular surface with the bone which forms the anterior part of the base of the brain-case, while there is in the middle a narrow bone, which, from its shape in man, has received the name of the *vomer* (ploughshare, *v*). The maxillary bones develop horizontal plates, which have the palate below and the nasal chamber above them.*



SKULL OF YOUNG OSTRICH FROM ABOVE (A) AND FROM BELOW (B).
(*After Owen.*)

(*of*) Occipital foramen; (*so*) Supraoccipital; (*eo*) Exoccipital; (*q*) Quadrate; (*pa*) Parietal; (*mp*) Pterygoid process; (*f*) Frontal; (*e*) Ethmoid; (*n*) Nasal; (*pm*) Premaxillary; (*m*) Malar; (*p*) Palatine; (*v*) Vomer; (*im*) Intermaxillary; (*l*) Lachrymal bones.

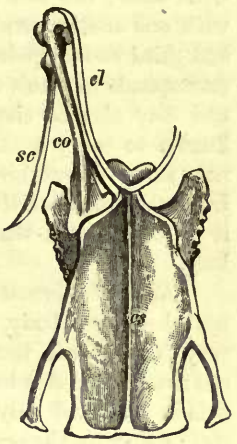
The lower jaw (*ma*) is composed of six pieces of bone on each side—the dentary, angular, surangular, coronoid, splenial, and articular. The upper part of the joint is concave.

The tongue is in relation, as regards its support and movements, to the *hyoid* bones, which will be especially noticed in describing the Woodpecker.

Turning to the vertebral column, we find a number of small bones, complicated in form, and more or less movable on one another. For convenience of description they may be divided into those which belong to the neck (*cervical vertebræ*), to the trunk (*dorsal vertebræ*), to the *sacrum* (so-called because it was offered in sacrifices!), or to the tail (*caudal vertebræ*). As has been observed already, the first of these, or the region of the neck, is very long, and is always long enough for the beak to be able to reach to the base of the tail. In birds, unlike mammals, the number of these cervical vertebræ may be as low as nine, or as high as twenty-four. The first of them, which is known as the *atlas*, has on its front face a rounded cavity into which fits the single projecting condyle, which was spoken of as being found at the back of the skull; and this condyle, being well rounded, is easily able to turn in the cavity which it fits, and the head is thereby capable of a large amount of movement. In the succeeding vertebræ it is possible to make out a body, an upper arch, through which passes the spinal cord, which meets above in the middle line, and is produced into a more or less long spinous process set horizontally to the

* These plates may become united with one another in the middle line, and the birds that possess this arrangement have been called *Desmognathæ* (δεσμός, "a bond;" γνάθος, "jaw"); or they may be separated by a more or less narrow cleft, in which case the birds in which this is found are called *Schizognathæ* (σχίζω, "I cleave"). As a matter of fact, the term Schizognathous is confined to those birds in which the above-mentioned vomer is pointed in front, while where it is truncated the birds are called *Ægithognathæ* (αἴγιθος, "a sparrow," as the character is seen in these birds). In these groups, however, the Ostriches, or running birds, which are distinguished by having no keel to their sternum, are not included; nor in them is the vomer narrow behind. This broad character of the hinder end of the vomer is seen also in one group of birds with a keeled sternum—the Tinamous—which are consequently distinguished from other "Carinate" birds by the term *Dromæognathæ* (*Dromæus*, the Emu).

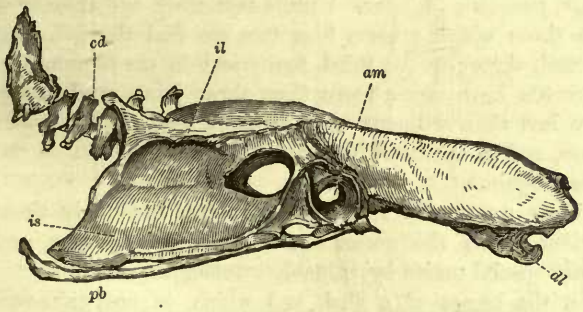
"body," and others directed forwards and backwards, so as to connect each vertebra with its neighbours; and lastly, a lower arch, the two halves of which are not connected below, but are converted into the more or less long ribs. As these vertebræ are so small it is clear that if their spines were long the free movement of the neck would be greatly impeded, and they are therefore in many cases little more than projecting processes. This free movement is further greatly aided by the characters of the two faces of the body (or *centrum*) of each vertebra; the face of each is saddle-shaped, that is to say, the anterior face is concave from side to side, and convex from above downwards, while the reverse of this is seen on the posterior face; in addition to this the vertebræ are separated by a disc of cartilage from one another. The region of the neck is, broadly speaking, distinguished from that which succeeds it by the fact that the ribs connected with its vertebræ do not reach to the sternum, or breast-bone. In all birds which are capable of flight this dorsal region has its parts firmly united together, and the same holds for the parts which follow, till we reach the region of the tail, where the more anterior vertebræ are movable on one another, so as, perhaps, to serve in aid of the steering organ formed by the rectrices, or feathers (*co*). In all living birds the caudal vertebræ are a good deal shorter than the body, but in the fossil *Archæopteryx* they are longer.



STERNUM OF PREGILUPUS VARIUS. (*After Murie.*)
(*cl*) Clavicle; (*sc*) Scapula; (*co*) Coracoid; (*cs*) Keel of Sternum.

The only important point to note with regard to the ribs, is the presence on some of them of backwardly directed hooked processes (*up*, fig. on p. 241), which aid in giving firmness to the thoracic region. The number of ribs is variable, but there is never a large number connected with the dorsal vertebræ, as there are in some Carnivora, in Hyrax, and in the Horse.

The fore and hind limbs are connected to the body by a series of bones, which form the breast and hip girdles respectively; with the former series is also connected that large, long bone with its sharply-projecting ridge (*is*), which is known as the breast-bone, or sternum, and in the depressions on which so much muscle is collected. This sharply-projecting ridge to the sternum, which is known as the carina, or "keel" (*cs*), is found only in the flying birds, though here and there, as in the Parrot of New Zealand (*Strigops*), it is very rudimentary. The lower edge of the bone is often imperfect, so that, as in the fowl, there are two deep clefts on each side, or there may be but a single cleft, and this again may be converted into a rounded space; in all cases these clefts or holes are covered, or filled by membrane, during the life of the animal. Projecting in front of the sternum, and often intimately connected with it, are the two clavicles (*cl*), which unite in the middle line to form the bone of childhood's delight—the furcula, or "merry-thought." Above, this bone is connected with two bones, one of which, called the coracoid (*c*), descends on each side to fit into a depression on the upper edge of the sternum, while the other, known as the scapula, or shoulder-blade (*sc*), is set at an angle to the coracoid. The scapula has a backward and downward direction; while it may be noted that among mammals the coracoid is well developed only in *Echidna* and *Ornithorhynchus*. These two last bones form, at their point of junction, a cavity into which is fitted the head of the long bone of the arm (wing). In the Ratitæ, it must be observed, these two bones are not set at an angle to one another, and they become more firmly united together.



PELVIS OF AN ADULT FOWL, SIDE VIEW. (*Reduced.*)
(*After W. K. Parker.*)
(*il*) Ilium; (*is*) Ischium; (*pb*) Pubes; (*dl*) Dorso-lumbar vertebræ; (*cd*) Caudal vertebræ; (*am*) Acetabulum.

As in all the vertebrate animals except fishes, the fore-limb may be divided into three parts (fig. on p. 237)—upper arm, in which there is one bone, the humerus (*a*); fore arm, in which there are two, radius (*d*) and ulna (*c*); and hand (E), which can again be divided into three parts, which in man would be called wrist, palm, and fingers. Now, in some animals the wrist-bones may be ten in

number, and the palm-bones five, while the number of small bones in the fingers varies a good deal, but the number of fingers is *five*. In most birds all these numbers are reduced. Just beyond the fore arm, the larger bone of which has often small projections indicating the points at which the secondary feathers have been attached, there are two small bones (*f*), then comes a longer bone (*g h i*), as it seems, in which there is an elongated space. Now, this bone consists of three metacarpals and one wrist-bone; the two outer metacarpals are absent, the two innermost ones have completely united with one another, and with the (true) middle metacarpal bone at their upper end; while the second and third metacarpals are also united at the other—or finger—end. The inner digit (*k*), or that which corresponds to man's thumb, has two joints (*phalanges*), and may be clawed; the next has three joints, and may also be clawed; while the third finger, which has never more than two joints, is never known to carry a claw. In the *Archæopteryx* the metacarpal bones are well developed, and are not, as in recent birds, united together. No idea of a bird's flying powers can be fairly gathered from the length of the hand, for it is long in Swifts and short in Albatrosses, for example; although it is to be noted that in the former the single bone (*humerus*) of the arm is short, and in the latter long.

As in the breast-girdle, the bones of the hinder or hip-girdle, by which the hind-limbs are connected with the body, are three in number; of these the upper one is greatly flattened out and projects very far forwards, thus aiding in the formation of the firm back of flying birds; the other two bones are much more slender, and are directed backwards and downwards. It is a curious circumstance that it is in one bird only, in either case, that these bones are directly connected at their lower ends with their fellow on the opposite side; those which are known as the *pubes* (*pb*) are so in the African Ostrich, and those which are known as the *ischia* (*is*) in the Rhea of South America. These two bones, with the large, flat *ilia* (*il*), take part in forming the cavity in which the head of the thigh-bone plays; the outer of the two bones (*fi*) which are found in the leg is rarely as long as, and is always much more slender than the other (*ti*), which has a strong ridge on its front face. There is yet another very remarkable point of resemblance between birds and reptiles, in that the "ankle-joint" is in both cases situated between the two rows of bones which make up the "ankle" (*tarsus*). In birds this arrangement is carried to a still further extent, for the single bone of the upper row is early united with the shin-bone, as may be seen under those unfortunate circumstances in which the poulterer has provided an aged fowl (aged, that is, for eating); in more fortunate cases it will be found possible to separate a small bone from the lower end of the shin-bone of the leg.

In no case does any bird, even *Archæopteryx*, possess a fifth toe. Unlike mammals, the number of joints in the toes varies greatly in birds. In those which possess four toes we find the following number of joints: in the first, two; in the second, three; in the third, four; and in the fourth, five. This rule holds for nearly all birds, but the Swifts have never more than three joints, and in the Goat-sucker and the Sand Grouse there are two less than ordinary on the fourth toe. In a number of birds the inner toe (big toe of man) disappears, and in the Ostrich proper the next division of the "typically" five-toed foot, or second toe, has no toe-joints.

In dealing with the muscular system of birds, we need here concern ourselves with only those special muscles which are modified in accordance with the necessities of the bird's habits, and those other muscles which have been brought into special notice by valuable investigations.

That great fleshy mass which is found on the breast of a bird, and which is not unknown to those who are fond of a good "dish," consists of three separate muscles, two of which depress, while the other elevates the wing. The presence of the elevator muscle on the lower side of the sternum is a curious arrangement by which the centre of gravity of the animal is lowered—a most necessary condition in flight; the tendon from this muscle passes through a pulley-like canal to be inserted into the upper side of the head of the bone, which, as has already been explained, is known as the humerus, so that when it contracts it draws this bone up. The ability of the wings to resist the pressure of the air is clearly dependent on the power possessed by these muscles. Borelli has calculated that the "pectoral muscles" of the bird exceed in weight all the other muscles taken together, whilst in man the pectoral muscles are but a seventieth part of the mass of the muscles.

The large and important muscles, which in the Mammalia constitute the *diaphragm*, or

midriff, are ordinarily said to be absent in birds, and, indeed, in most cases are but feebly represented. In the Ratitæ, and especially in the New Zealand form (*Apteryx*) of this group, the diaphragm may attain to a very fair degree of completeness, though even here the apex of the heart is allowed to pass into the abdominal cavity. The muscles of the back are feebly developed, as might be imagined from the firm character of the spinal column; and as the fore limb exhibits but slight power of *varying* its movements, its muscles are not well developed. Those muscles which are found in the skin are, on the contrary, expanded into broad pieces; and special bundles are sent to the larger feathers of the wings and of the tail, and to those folds of skin which connect the upper arm with the trunk, and with the fore arm, respectively. Borelli thus explains the arrangement by which a perching bird remains fixed when asleep: A muscle which arises from the *pubes* bone of the hip-girdle passes over the knee, and then takes a backward direction so as to pass behind the ankle; it thus becomes one of the flexor muscles, by the contraction of which the toes are flexed, or bent. When the perching bird, which, as we know, has one of its toes directed *backwards*, is seated on a bough, the thigh has its upper end directed backwards, while the upper joint of the leg is turned forwards, or in other words, the two parts of the leg have opposite directions. This arrangement acts as a contracting influence on this muscle and its tendons, while the weight of the bird is sufficient to preserve this condition and the consequent flexion of the toes.

To turn to those muscles the arrangement of which has been made the basis of a suggested classification. In the leg of the bird there are, among others, four muscles, the names of which are *femoro-caudal*, *accessory femoro-caudal*, *semi-tendinosus*, and *accessory semi-tendinosus*, any of which may be absent, but in those cases where a single muscle only is found the first is always present; again, there is a muscle which, from its course, is known as the *ambiens*, and this, too, may be present or may be absent. As the presence or absence of any of these muscles is a very constant phenomenon in any given section of birds, it has been proposed to divide the class into those which do, and those which do not, possess the above-named *ambiens* muscle. In the latter group the second of the four above-named muscles—the accessory femoro-caudal—is never present.*

Of all the muscles, those which act in aid of the vocal organs are of the greatest interest, but they will be considered a little later on.

A valuable suggestion has been made, which, if followed out, may lead us to understand how it is that the brain of the bird, which is so simple as compared with that of man, is nevertheless capable of so much intelligent activity. Bearing in mind the axiom that it is quality not quantity that tells, and looking at the fact that the brain of the most highly intelligent man is, after death, supposed to be similar to that of the foolish and of the unwise of our race, it is obvious that the essential difference must lie elsewhere than in the coarser, or more evident, characters of that organ which is known as the brain. The suggestion, then, that was made, was to the effect, that the possessors of aviaries, in which it was possible to study the characters of birds, should submit the brains of their deceased favourites to that more thorough investigation which the microscope allows of. The brains of birds vary but little in their anatomy. The optic lobes are rounded, paired, and tubercular in the bird, and are not divided into four, as in mammals; they are found at the lower part and sides, and not in the upper part of the brain. The *cerebellum* is not continued at the sides into distinct lobes; nor are the two lobes of the brain (or *cerebral hemispheres*)

* The presence or absence of it, or of the other muscles, is used as a means for arranging the smaller divisions of the larger groups into which the two first-named sub-classes are, by the aid of other anatomical facts, divided. One striking advantage of this system, as suggested by the late Prof. A. H. Garrod, is that the characters of the *ambiens* have been observed to go hand in hand with certain other characters. Thus, the cæca found at the end of the small intestine are always present in the Homalogonatæ, or birds having the normal arrangement of knee-muscles; but in this connection there is another structure to be mentioned, namely, the so-called oil-gland, or gland by the secretion of which the bird "preens" its feathers, and which is always set in the skin in the region of the tail. Now this "uropygial," or oil-gland, may or may not be provided with a tuft of feathers, and as there may or may not be cæca to the intestine, it follows that—(1) the gland may be tufted and there may be cæca, or (2) the gland may have no feathers and cæca may be present, or (3) there may be no cæca and a tufted gland, or (4) there may be no cæca and no tufts (the possible arrangement of neither being present is found in a few Pigeons). But this is not the place to follow out the details of this classification.

With regard to the proposition made by a French observer, M. Alix, that birds should be divided into the Homœomyarii, Entomyarii, and Ectomyarii, according to the character of certain of the flexor muscles at the back of the leg, it seems only necessary to remark that so far anatomical investigations have not supported his views, while his system would separate birds which seem to be closely allied.

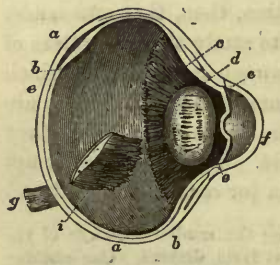
provided with those convolutions which, in mammals, seem to increase in complexity of character as the animal rises in the scale of intelligence. The cerebrum does not cover the cerebellum. Small as is the brain of birds, it is found that, in many, its weight is, as compared with that of the body, much greater than it is in man.

With reference to the spinal cord, or the continuation of the central part of the nervous system through the vertebral column, it is only necessary to remark that it is much increased in width at the two regions, in which the nerves for the fore and hind limbs are respectively given off; that there is a narrow canal running along its centre, and that at the lower end there is a large space. In regard to the cerebral nerves, those for the eyes are of great size.

Coming now to consider the organs of the senses, and beginning with the eye, it is interesting to note that there are no blind birds, and, indeed, the eyes are of a large size as compared with the brain. They are generally placed at the sides, though the nocturnal birds of prey (in which they are directed forwards) are an exception to this rule. It is in very rare cases that eyelashes are present, and although they seem to exist in the group just mentioned, it is probably more correct to look upon them as slightly modified feathers.

If the eye be regarded as having on its front face, a part which would, if completed, form part of a smaller circle than the rest of the eye, it is clear that this *cornea*, or front part, would be more convex than the rest, and that it would consequently be a "more powerful glass," inasmuch as it would exert a greater bending (refracting) influence on the rays of light which pass through it, while, further, it is clear that the more convex it is the better "glass" would it be. Now this is just what happens in birds: the *cornea* is very convex; in addition to this, the long axis of the eye, on the length of which it seems that, in many cases, the condition known as that of being "short-sighted" depends, is very long in some birds, and notably in the Owls.

The eye is covered in by a firm and strong membrane, which is known as the "sclerotic;" this, in its front part, develops a number of bony plates; of these there may be as many as twenty, and they are capable of a certain amount of free movement on one another. What is known as the power of accommodation depends upon the extent to which the front face of the somewhat lens-shaped body which helps to separate the eye into two chambers is capable of being rendered more or less flat; this front face is covered by a membrane which is found to be more or less taut, according to the state of contraction of the muscles (ciliary muscles) connected with it. A very little reflection is sufficient to show that a swiftly moving animal has the focus of its eye, or the point at which clear vision is alone possible, changed much more rapidly than an animal which moves more slowly. So much on the one side. On the other, it is to be observed that muscles vary in structure; they are either "smooth" or "striated," and it is the latter that contract the more rapidly. Putting these two series of observations together, it is easy to arrive at the result that a bird should have striated muscular fibre in its ciliary muscles, and a more slowly moving animal like man, smooth muscular fibres; and this we find to be the case! The *iris* is an arrangement by which the quantity of light admitted into the eye is enabled to be varied, and the small hole in the centre, through which the rays of light pass, is known as the *pupil;* this is always rounded in birds, and is never elongated as it is in some mammals—the Cats, for example.*



SECTION OF THE EYE OF THE COMMON BUZZARD.
(*After Macgillivray.*)

(*aa*) Sclerotic; (*bb*) Choroid Coat and Pigment; (*c*) Ciliary Circle; (*d*) Lens; (*ee*) Iris; (*f*) Cornea; (*g*) Optic Nerve; (*i*) Pecten.

But the most peculiar arrangement in the bird's eye is the presence, projecting into the hinder chamber, of a membrane in which run blood-vessels; this, which is known as the *pecten* (comb), or *marsupium* (pouch), enters the vitreous humour, which fills up this hinder chamber by the same cleft as the optic nerve. It is folded, and is generally of a quadrangular shape; it is not found in the eye of the Wingless Bird of New Zealand (*Apteryx*).

A third eyelid is well developed in this class; it is an elastic membrane (*membrana nictitans*, or winking membrane), which has not, like the other two, a vertical movement, but is drawn obliquely over the eye from the inner to the outer side. This movement is effected by two special muscles, one of which arises on the inside, and below the eyeball, and has therefore to pass over to the

* Compare Vol. I., p. 213.

outer side. In contracting, it would press on the optic nerve, were it not for the other one, which, however, is so disposed that by its contraction it draws away the tendon of the *pyramidalis* muscle from pressing on the nerve. As in ourselves, there are six special muscles for moving the orbit or ball of the eye, but the one which in man is well enough known as the *trochlear*, has no pulley-arrangements in birds. Lachrymal glands are present.

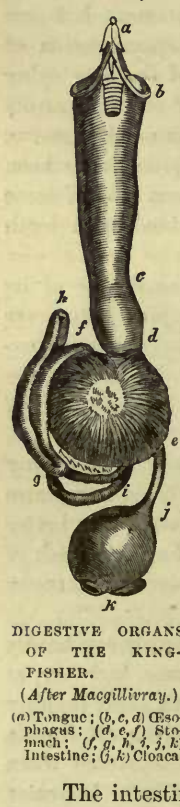
With regard to the organ of hearing, one particular part, which in man is in the form of a snail's shell, and is known as the *cochlea*, is not coiled into this shape in birds, being very slightly bent, though holding in other respects the same general relations. Nor is there any external ear, as in mammals, for collecting the waves of sound; there is, however, in the nocturnal birds of prey a crescent-shaped valve on which are set tufts of short feathers, and it is possible that this may aid in hearing. Nor, again, are there in the interior of the ear those three small bones, which are known generally as the auditory ossicles; of the two that are absent, one is thought by many anatomists to be represented by the quadrate bone, which, as has already been mentioned, connects the lower jaw of the bird with the skull. The single bone which is present, and which is, perhaps, most generally known as the "columella," is connected by two or three cartilaginous processes with the drum of the ear, and by the other end—at which it has a small oval plate—with the more internal parts of the organ of hearing. In man there is a curious arrangement of rods, which vary in so remarkable a way as to have led to the supposition that each was adapted to a distinct note; these rods, which constitute the organ of Corti, are not present in birds, affording thereby a striking example of the law that physiological inferences are often well examined by the aid of comparative anatomy, no physiologist being hardy enough to deny to birds the power of appreciating those delicate modulations of sound which go to make up the chief charm of music. With regard to the organ of smell, it is only necessary to note the absence of those muscles by which, in man and other mammals, the nostrils are contracted or dilated.

The first point which attracts us on examining the digestive tract of birds is the absence of lips and of teeth; but with regard to these latter we must note that it is a character which has only become distinct since the time when birds were first developed. This statement is borne out by two series of facts, each taken from one of the two great aids to a correct apprehension of the real importance of structural characters—that is, from embryology, or the study of the developing individual; and from palæontology, or the natural history of the past. The young of certain Parrots have been observed to possess, at an early stage of their development, those uprisings on the mucous membrane of the jaw which go by the name of "dental papillæ," and these papillæ have been seen to be covered with a cap of dentine. On the other hand, the researches of Owen and of some American palæontologists have brought to light bird-like forms which were provided with teeth (Odontornithes: *Ichthyornis*, *Hesperornis*).

The *beak*, or horny covering of the jaws, varies very greatly in form, and in the degree of its sensibility. This tactile sense is dependent on the extent to which the beak is supplied by nerves (from the fifth cerebral nerve). In the Woodpecker, for example, there is a large branch extending along the inside of the lower jaw, which, as it approaches the extremity, breaks up into finer nerves that perforate the bone by a number of small canals and so give to the beak a power of discovering what lies hid in the crevices of the wood and under the bark. Being an external structure, the beak is naturally adapted to the habits of its possessors, so that it may be hooked, as in many flesh-eating forms, or trenchant, and fit to cut and break, or provided with transversely-set fine plates by which the water taken in with the food can be filtered off, or provided with bristles, the better to hold a living prey. Finally, in many cases the hardness of the bill is made up for by a patch of naked skin at the base of the upper mandibles, which is known by the name of the "cere" and seems to have a tactile function.

In many birds, the tongue is either feebly developed, or is encased in horn, so that it can hardly be as useful an organ of taste as is our tongue: in the Pelicans it is obsolete. In some, however, as in the Woodpecker, the tongue is a very powerful seizing organ, as it is protruded with great rapidity by means of a special muscle, and is well provided with a sticky secretion, which is given off from a large gland (the sub-lingual), which, lying below the muscle above referred to, is compressed when this muscle contracts; so that in the Woodpecker, just as in the mammal called the Great Ant-eater (*Myrmecophaga*), the insect prey is easily captured.

The region of the mouth is not separated from that which follows it (the pharynx) by an epiglottis, which in ourselves protects the entrance into the air-passages, nor is there any uvula to guard the posterior orifice of the nose by which the air reaches the throat. The succeeding portion of the gullet (the œsophagus) is very long, as might be supposed from the length of the neck in most birds, and it is very frequently either dilated at one side, or produced into a cæcal pouch (crop, *ingluvies*), which may, or may not, be separated by a narrow connection, from the rest of the gullet, and which may be divided into two compartments. This crop serves for the detention of the food, which cannot have undergone any complete process of mastication, and it is here treated to a process of maceration by the fluid secreted from the walls of this organ. Passing from this receptacle, the food becomes subject to the action of the stomach proper, which differs, however, from our ordinary conception of a stomach, as seen in man, by being divided into two distinct portions. The anterior one is known as the *proventriculus*, and it is in this that the gastric juice is brought to bear upon the food, and its walls are consequently thickened by a glandular layer; the hinder division, which is known as the *gizzard*, forms an elongated sac, with two orifices—one from the proventriculus, the other leading to the small intestine—in its upper portion. The characters of its walls are very different in those birds which live on animal, as compared with those that live on vegetable (grains) food; in the former they are membranous and thin, but in the latter they are enormously thick and very muscular. On examination, it is seen that the dark colour of the muscles is on each side of the gizzard relieved by a shining spot of tendinous material, and the walls of the gizzard have consequently been compared to a double-bellied (digastric) muscle. The internal cavity of the gizzard is lined with a dense and rough coat, and is ordinarily found to contain small stones, and occasionally other hard materials. These obviously take the place of the absent teeth, when the muscles of the gizzard set up that (grinding or compressing) action by which the ingested seeds are broken down. The wall of the gizzard may itself also act as a rasping organ, being, as it often is, provided with a firm glandular layer, the secretion of which is converted into a hard lining, the structure of which has been observed in some cases to be due to interlaced filaments secreted from and continuous with the glands in the wall of the gizzard.



DIGESTIVE ORGANS OF THE KINGFISHER. (*After Macgillivray.*)

(*a*) Tongue; (*b*, *c*, *d*) Œsophagus; (*d*, *e*, *f*) Stomach; (*f*, *g*, *h*, *i*, *j*, *k*) Intestine; (*j*, *k*) Cloaca.

Notwithstanding the differences in the character of the gizzard in carnivorous and graminivorous birds, it has been shown by the ever-famous John Hunter that carnivorous birds can be brought to live on grains, and grain-eating birds on meat.

It is interesting, further, to note, with regard to the opening into the small intestine, that in a number of grain- or fruit-eating birds there is no valvular arrangement to detain the food in the gizzard till it is completely triturated, for it is thus that many plants have their area of distribution increased, the escaped seeds passing uninjured from the intestine to find, perhaps, a suitable soil in a new district. In those that swallow large stones a valve is often to be observed. The difference which we have already had so frequently to notice, as obtaining between the carnivorous and "vegetarian" birds, is seen to be continued into their small intestine; just as in mammals, this portion of the tract is longer in the latter than in the former birds. The anterior, or *duodenal* portion, is always characterised by forming a loop, within which lies the gland known as the *pancreas*, and the succeeding portion is, as compared with most mammals, short. A slight elevation, hardly ever of any great size, may at times be observed on the course of the short intestine. This represents all that remains of the duct by which the hatching bird was connected with the yolk. The short and straight large intestine is ordinarily separated from the preceding by a cæcum; this is generally paired (in the Herons and some others it is single), and varies in length; in many cases these cæcal tubes are hardly more than papillæ. In the Parrot, as in the Woodpecker and some others, these cæca are absent. In the desert-dwelling Ostrich (*Struthio*) they are said to be as much as two feet long; but in the Emu they do not exceed six inches in length.

The intestine ends in a cavity, which is common to it, and to the other organs that open to the exterior in this region. This *cloaca* (sewer) is found in reptiles also, and in one division of the

Mammalia, the Monotremata. In birds it is provided with a special glandular appendage on its upper (or *dorsal*) aspect, which goes by the name of the *Bursa Fabricii*. Neither the history nor the functions of this peculiar organ can be said to be thoroughly understood.

Of the organs which are appended to the intestine, the lungs will be described elsewhere; of the rest we have to consider the liver, the pancreas, and the spleen. The first-named organ is large, and covers over the pancreas, the proventriculus, the spleen, part of the gizzard, and part of the small intestine. It is ordinarily divided into two "lobes," between which, on the upper edge, is placed the tip of the heart. In the common fowl the left lobe is often divided into two; but this organ is never broken up into so large a number of parts as it is in many mammals, from which animals birds also differ in always having more than one duct to carry off the secretion of the liver (bile) to the small intestine, except in the Ostrich; in this, as in some other birds, there is no gall-bladder in which the bile may be collected, so that in such this secretion passes directly into the intestine.

As has been already pointed out, the commencement of the small intestine forms a loop, in which is set the organ known as *pancreas*, which may for simplicity be described as the salivary gland of this region, although in truth the fluid secreted from it is a much more powerful aid to the digestion of food than that of any known salivary gland. It has always two, and in a number of cases three ducts, which do not unite with the bile ducts, but open separately from, though near them, into the end of the "duodenal loop." The *spleen*, which is a small oval body, and is placed to the right of the proventriculus, has no ducts; in birds of prey it is more cylindrical in shape.

The temperature of the blood of the bird is, in requirement with the conditions of its existence, hot—that is to say, it is ordinarily hotter than the temperature of the surrounding air, and is found to register between 100° (Gull) and 112° (Swallow) on Fahrenheit's scale, or from two to fourteen degrees more than does that of man. Birds and mammals, are, speaking broadly, the only hot-blooded animals now existing, and it has consequently been suggested that they should be grouped together as such, in opposition to the rest of the Vertebrata. But it is obvious that this character of the temperature is merely dependent on physiological conditions; and were this a treatise on the anatomy of birds rather than one on their natural history, the statement of this fact would not receive the prominence here given to it. The high temperature of any body may be preserved from cooling influences by two methods: thus, tea in a well-polished silver teapot keeps hot because the rays of heat are but slightly radiated from its surface; or a less costly teapot may be kept hot by covering it with a loosely-fitting "cosy," which, being made of badly-conducting materials, "keeps the heat in." It is, then, clear that the heat of a body is best preserved when it is covered by a bad radiator and a bad conductor of heat; and this is just the case with birds: the polished feathers are bad radiators, and the air entangled among them forms a bad conductor.

The blood corpuscles are, broadly speaking, about twice as large as in man; those which are coloured red are oval in shape, as they are in nearly all of the lower Vertebrates and in the Camels among mammals. Like the white ones, they are "nucleated." The heart is, as in mammals, divided into four chambers. It is a condition of the circulation in hot-blooded and rapidly-breathing animals that the current of *arterial* blood *from* the heart, and the current of *venous* blood *to* it, should be kept as much as possible separate; no reflection is needed to show that the blood freshly purified by contact with the air in the lungs must be kept as distinct as can be from the blood which has lost its purity in passing through the body; in other words, it is required that there should be a similar result in birds and in mammals.

Birds, like all warm-blooded creatures, have the heart divided into four cavities—two ventricles and two auricles—those of the right side being completely separated from those of the left. The whole is enclosed in a pericardium, a thin, but strong, membrane. The right ventricle has thin muscular walls, and almost completely envelopes the left. The right auricle has a remarkable valve in the shape of a fleshy leaflet, which appears almost to be a portion of the inside of the ventricle that has become detached from the partition between the two ventricles. The blood, under certain circumstances, passes between this septum, or partition, and the leaflet, into the auricle; but when the beat of the heart takes place (the systole), the septum, being convex, is forced against the leaflet on the other side of the auricolo-ventricular opening, and the passage of the blood, through this, is

prevented. The valve between the stout-chambered left ventricle and auricle does not present this structure, but is divided into two or three lobes attached to tendinous processes. At the origin of the great vessels—the pulmonary artery and the aorta—there are three valves, semi-lunar in shape and by name. And this last vessel, often having given off the coronary artery to the heart itself, is curved to the right, and then passes backwards to go down the body. The blood from the body is collected into three large veins—two anterior *venæ cavæ* and one posterior.

The lymphatic system is well developed, and of the so-called "lymphatic hearts," which are well known in the Frog, the posterior ones have been observed in some, and especially in the Ratite birds.

The lungs, or organs in which the blood effects an exchange of its gases with the outer air, are paired, and set on either side of the heart. As is elsewhere mentioned, the nostrils are not provided with muscles, and there is no *epiglottis* sufficiently well developed to cover the entrance into the long tube, or *trachea*, which runs down the neck. This tube, which does not always take a straight course, is essentially made up of a number of rings of cartilage, which are for the greater part perfect, and not, as in man, imperfect rings. The *bronchi* which are given off from this tube, to the right and left, have their rings imperfect, and they do not show that two-forked mode of division which is so characteristic of mammals. The lungs are of a rosy colour, and of a comparatively small volume; they are marked externally by depressions corresponding to the characters of the vertebræ and ribs, to which latter they are firmly attached, and they are not divided into *lobes*; in their texture they are spongy; the air-tubes are given off from them at right angles to the main air-passage; these run nearly parallel to one another, and contain in their walls the true tissue of the respiratory organ. The air-tubes are also connected with the air-cells, which are arranged in so remarkable a manner as to deserve a full account.

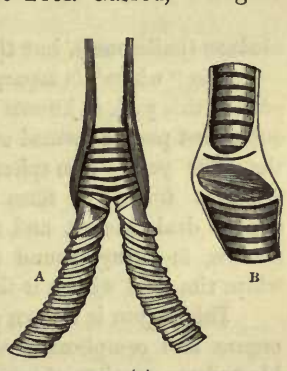
They are found in all birds with the exception of the *Apteryx*, according to Professor Owen. Our knowledge of their existence is primarily due to the illustrious William Harvey, while it is to the distinguished anatomist, John Hunter, that we owe our knowledge of the very curious fact that these air-passages and sacs communicate also with the cavities of some of the bones of the skeleton. Though these sacs are not by any means highly vascular, or supplied with vessels to the same rich extent as are the lungs, they are nevertheless of enormous importance to the bird; thus, they diminish the specific gravity of the animal. For example, taking a bird which weighs 1,600 grammes, and has a volume of 1,230 cubic centimetres —or a specific gravity of 1·30 $(\frac{1600}{1230})$ it has been calculated (Bert) that 200 cubic centimetres of air can be introduced; now these centimetres would weigh ·22 of a gramme, so that the specific gravity of the animal would be reduced to 1·05 $(\frac{1600+0{\cdot}22}{1230+200})$ or $(\frac{1600{\cdot}22}{1520})$. Again, the air which is taken into the lungs is, in high-flying birds, often of an extremely low temperature; but this air is not only brought into contact with that of the lungs, but also with that which has been warmed in the abdominal cavity. And again, the air is often very dry—as it is for the Ostrich on the desert plains of Africa—but the air from the air-sacs contains a large amount of moisture. Of the proper air-sacs there are nine; of these, four—the two anterior and the two posterior *thoracic*—lie in the thorax (breast) proper; three—the right and left cervical, and the sac between the *clavicles*—lie in front of the thorax; while the last two are found behind it and in the abdomen. From all of these, with the exception of those within the thorax, communications are, or may be, given off to the bones of the vertebral column, to the humerus, to the bones of the thigh, and to the sternum and the ribs; but there is no communication between these sacs and the air-spaces which are so constantly found in the bones of the skull, and which are in connection with the air-cavities of the ear and of the nose. The inter-clavicular sac has been observed to be covered with a thick layer of muscle in those birds, at any rate, which perform somersaults, and it has been suggested that this layer of muscle is capable of driving the air in the sac backwards. It is obvious that such an operation would send the centre of gravity of the animal nearer the head, and would, so far, be of assistance in the execution of the curious movement alluded to.

It has been suggested that the air-sacs are of assistance in increasing the resonance of the bird's voice. Be this as it may, attention must now be turned to the organ of voice. This organ may take one of three forms, or, if absence is to be counted, four. There is no organ of voice in the Ratitæ, or in the American Vultures (*Cathartidæ*). It is, when present, remarkable for being developed at the lower, and not at the upper, end of the *trachea*; while the true *vocal cords*, which,

by their vibration produce the notes of the human voice, are altogether and always absent from the larynx; in other words, the vocal organ is not the *larynx*, but an organ seated at a lower level, and known as the *syrinx*. This instrument may, further, be formed in the trachea alone (as in some American Passerines), or in the bronchi alone (as in Steatornis), or at the point at which the tracheal and bronchial tubes pass into one another (as in the majority of singing birds).

The last-mentioned, or *bronchio-tracheal syrinx*, consists of the following parts; (i.) a *tympanic* chamber formed by the union of some of the lower rings of the trachea; (ii.) a membranous *septum* separating from one another the tracheal orifices of the two bronchi; (iii.) on either side a *tympaniform membrane*, formed on the inner side of the uppermost bronchial rings; in consequence of this these bronchial rings are not complete circles; their mucous membrane is developed into a fold which bounds one side of a cleft which is formed by the presence on the other side of the above-mentioned tympaniform membrane. The air which passes through these bronchial clefts sets in vibration the membranes which bound them, while the character of the note is affected by the position of the bronchial half-rings, and the length of the column of air in the trachea. These rings have their positions changed by five lateral muscles, which act on their ends, and so rotate, them. The principle variations in the characters of the muscular supply of the organ of the voice were long ago worked out by Johannes Müller, the famous German anatomist and physiologist.

It is also to this observer that we owe our first information with regard to the bronchial syrinx of Steatornis; the anatomy of this animal was also investigated by the late Prof. Garrod, who gave the following account of its vocal apparatus:—"Each semi-syrinx, as it may be termed, is formed on the same principle as that of the combined organ in most of the non-singing birds. Taking for description that of the left side, it is found that the thirteenth bronchial ring is complete, though considerably flattened from side to side; the fourteenth is not complete in the middle of its upper surface; it is a little longer from before backwards than the one above, and not so long as the one following it. The fifteenth is only a half ring, its inner portion being deficient; it is slightly convex upwards, and articulates, both at its anterior and posterior ends, with the fourteenth incomplete ring and the sixteenth half-ring. The sixteenth half-ring is concave upwards, and so forms an oval figure in combination with the one above, which is filled with a thin membrane to form part of the outer wall of the bronchus. There is a membrane also between the ends of these and the succeeding half-rings, which completes the tube of the bronchus internally."



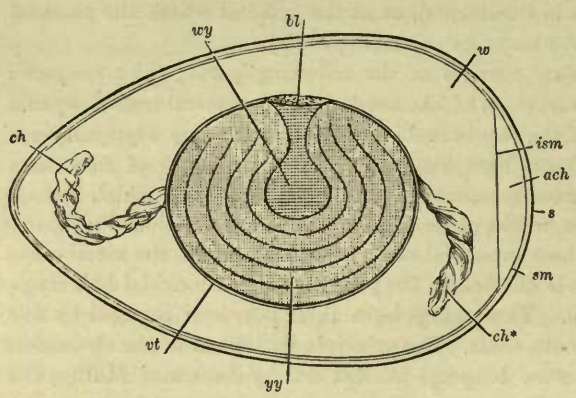
FRONT VIEW (A) AND SECTION (B) OF INFERIOR LARYNX OF PEREGRINE FALCON.
(After Macgillivray.)

The ducts from the urinary organs open to the exterior through the cloaca, into which, as already mentioned, the digestive tube also opens. The chief point with regard to the urinary secretion of birds is the fact that it is *semi-solid*, and that it contains a quantity of the substance known as *uric acid*. The kidneys are placed some way back and near the cloaca; they are set on either side of the spinal column, between the transverse processes of the sacral vertebræ, and are generally divided into three portions of greatly varying size. On their inner edge are given off the *ureters*, which pass on each side to enter separately into the before-mentioned cloaca.

The right ovary of birds is always atrophied, and it is in rare cases only that rudiments of it are found (namely, in the diurnal Raptores). The *oviduct* is a coiled canal, the lower portion of which has strong, muscular walls, while internally the characters of its surface vary according to the substance which the glands of different regions add to the descending egg. The right oviduct is not so completely atrophied as is the ovary of the same side. This duct opens into the cloaca through which the egg passes to reach the outer world; as further development is so largely independent of the mother, the female organs offer no peculiarities of arrangement, or complexities of structure.

All birds lay eggs, or, in other words, the born young are not carried about by the mother till the time of birth. The advantage of this to a flying animal is so obvious that we may pass at once to describe the egg of a common fowl. The shell, which consists of organic matter and lime-salts, is found to be formed of two layers; it is in the outer one only that pigment is found. Both layers are traversed by canals, through which air can pass only when the shell is dry;

that is to say, the outer pores of the shell are closed under the influence of moisture. This may be seen by removing the outer layers, when air or water will pass in quite easily. These canals are said to be branched in the Ratite birds, and to be simple in the Carinatæ. The shell is lined by the shell-membrane, which, again, is made up of two layers. At the broad end of the egg these two layers are separated from one another, and so give rise to that air-chamber which is found in stale eggs, and increases in size as the egg grows older and the yolk evaporates.



DIAGRAMMATIC SECTION OF A FOWL'S EGG.

(*bl*) Blastoderm; (*wy*) White Yolk; (*yy*) Yellow Yolk; (*vt*) Vitelline Membrane; (*w*) Albumen; (*ch*) Chalazæ; (*ach*) Air-chamber; (*ism*) Internal Layer of Shell Membrane; (*sm*) External Layer of ditto; (*s*) Shell.

The shell-membrane is in direct contact with the *white* of the egg (*albumen*). This, in its fresh state, consists of fluid albumen, arranged in layers, which are separated from one another by networks of fibres, in the meshes of which, however, fluid albumen is also to be found. There are, further, two special sets of fibrous cords in the white of the egg; these extend somewhat along the long axis of the egg, though they do not reach to the shell-membrane. From their bead-like character they are known as *chalazæ* (hailstones), but their more common English name is that of the "tread."

The "white" is separated from the *yolk* by the so-called *vitelline* (or *yolk*) membrane; the greater part of this yolk is known as the *yellow yolk*, and is made up of minute albuminous granules, but its outermost part is formed of a thin layer of a somewhat different substance, which goes by the name of the *white yolk*. The spheres of this latter are still smaller than those of the yellow yolk, and they are also found to form layers at various levels in it. At one point the white yolk becomes a good deal thicker, and forms, as it were, a pad for a small white disc, which, in ordinary circumstances, is always found uppermost when an egg is opened. This disc is formed of an encircling white rim, and within it there is a rounded transparent region, the centre of which is more opaque.

This region is known as the *blastoderm*, and is that part of the egg from which the chick, with its organs and complicated vessels, muscles and bones is soon to be developed. In the laid egg, this blastoderm consists of two layers of cells, as do at a certain stage the eggs of all but the very simplest of animals. The dissection of a laying fowl will probably reveal the presence of eggs at an earlier stage, and from their study the following history has been made out: the ellipse-shaped egg, when about to leave the ovary, is a yellow body enclosed in a fine membrane, and possessing at one pole a small (*germinal*) disc; this disc contains a smaller *germinal vesicle*, and a still smaller *germinal spot;* when this body is ripe, it escapes from its enclosing capsule, and the germinal vesicle disappears. As the egg passes down the *oviduct* the albumen becomes deposited around it, and part of it is converted into the shell-membrane. The egg now becomes subjected to a thick, white fluid, which is gradually converted into the shell.

While these additions to the substance of the egg are going on, the germinal disc undergoes the remarkable process known as segmentation, in which it becomes divided into two, four, eight, sixteen, thirty-two (and so on) masses, which arrange themselves in two distinct layers, the presence of which has been already noted in the laid egg.

This is not the place in which it is possible to follow out the various future changes undergone, but the condition of the young birds on escaping from the egg is widely different in some of the larger groups of birds. Some young birds, on their exclusion from the egg, are able to shift for themselves, and are covered with down; while others are born naked and helpless, and require food from their parents for some time after they are hatched. Of the first section, an ordinary chicken is a familiar example, while a young Thrush or a Sparrow illustrates the second. There are, however, manifest exceptions to this rule, as in the Herons, for instance, where the young are densely clothed with feathery down, but are helpless for a long time after they are hatched.

Finally, it must be stated that all birds possess an oil-gland (known as the uropygial), situated

near the tail, with which they clean and dress their feathers. Attention has already been called to this gland in the foot-note on p. 245.

Before commencing the special part of the present article, it may be useful to give a slight sketch of the classification which it is proposed to follow throughout its course.

CLASS AVES.

DIVISION I.—CARINATÆ: CARINATE BIRDS.

ORDER I.—ACCIPITRES: BIRDS OF PREY.

SUB-ORDER I.—FALCONES: FALCONS.

Family I.—Vulturidæ - - - - - Vultures.
,, II.—Falconidæ - - - - - Hawks.
Sub-Family I.—Polyborinæ - - Caracaras.
,, II.—Accipitrinæ - - Long-legged Hawks.
,, III.—Buteoninæ - - Buzzards.
,, IV.—Aquilinæ - - - Eagles.
,, V.—Falconinæ - - - Falcons.

SUB-ORDER II.—PANDIONES: OSPREYS.

SUB-ORDER III.—STRIGES: OWLS.

Family I.—Bubonidæ - - - - - Owls proper.
,, II.—Strigidæ - - - - - Barn Owls.

ORDER II.—PICARIÆ: PICARIAN BIRDS.

SUB-ORDER I.—ZYGODACTYLÆ: CLIMBING BIRDS.

Family I.—Psittaci - - - - - Parrots.

a.—*Psittaci proprii.*

Sub-Family I.—Camptolophinæ - Cockatoos.
,, II.—Androglossinæ - Fleshy-tongued Parrots.
,, III.—Conurinæ - - - Conures.
,, IV.—Platycercinæ - - Parrakeets.
,, V.—Strigopinæ - - Owl Parrots.

b.—*Psittaci orthognathi.*

,, VI.—Trichoglossinæ - { Brush-tongued Parrots.

Family II.—Cuculidæ - - - - - Cuckoos.
,, III.—Indicatoridæ - - - Honey-guides.
,, IV.—Musophagidæ - - - Touracoes.
,, V.—Picidæ - - - - - - Woodpeckers.
,, VI.—Rhamphastidæ - - - Toucans.
,, VII.—Capitonidæ - - - - Barbets.

SUB-ORDER II.—FISSIROSTRES: WIDE-GAPING BIRDS.

Family I.—Galbulidæ - - - - Jacamars.
,, II.—Bucconidæ - - - - Puff Birds.
,, III.—Alcedinidæ - - - - Kingfishers.
,, IV.—Bucerotidæ - - - - Hornbills.
,, V.—Upupidæ - - - - Hoopoes.
,, VI.—Meropidæ - - - - Bee-eaters.
,, VII.—Momotidæ - - - - Motmots.
,, VIII.—Coraciadæ - - - - Rollers.
,, IX.—Trogonidæ - - - - Trogons.
,, X.—Caprimulgidæ - - - Goatsuckers.
,, XI.—Cypselidæ - - - - Swifts.
,, XII.—Trochilidæ - - - - Humming-birds.

ORDER III.—PASSERIFORMES: PERCHING BIRDS.

SECTION A.—ACROMYODI: SINGING BIRDS.

SUB-ORDER I.—TURDIFORMES: THRUSH-LIKE BIRDS.

GROUP I.—COLIOMORPHÆ: CROW-LIKE PASSERES.

Family I.—Corvidæ - - - - - Crows.
Sub-Family I.—Corvinæ - - - Crows proper.
,, II.—Fregilinæ - - - Choughs.
Family II.—Paradisiidæ - - - - Birds of Paradise.
,, III.—Orioliidæ - - - - - Orioles.
,, IV.—Dicruridæ - - - - Drongos.
,, V.—Prionopidæ - - - - Wood-shrikes.

GROUP II.—CICHLOMORPHÆ: THRUSH-LIKE PASSERES.

Family VI.—Campophagidæ - - - Cuckoo-shrikes.
,, VII.—Muscicapidæ - - - Flycatchers.
,, VIII.—Turdidæ - - - - - True Thrushes.
Sub-Family I.—Turdinæ - - - Thrushes.
,, II.—Sylviinæ - - - Warblers.
Family IX.—Timeliidæ - - - - Babbling Thrushes.
Sub-Family I.—Troglodytinæ - Wrens.
,, II.—Brachypodinæ - Bulbuls.
,, III.—Timeliinæ - - - Babblers.
,, IV.—Cisticolinæ - - Grass-warblers.
,, V.—Miminæ - - - American Babblers.
Family X.—Laniidæ - - - - - Butcher-birds.
,, XI.—Vireonidæ - - - - Greenlets.
,, XII.—Paridæ - - - - - Titmice.

GROUP III.—CERTHIIMORPHÆ: CREEPERS.

GROUP IV.—CINNYRIMORPHÆ: HONEY SUCKERS.

SUB-ORDER II.—FRINGILLIFORMES: FINCH-LIKE BIRDS.

Family I.—Motacillidæ - - - - Wagtails.
,, II.—Mniotiltidæ - - - - American Warblers.
,, III.—Cærebidæ - - - - American Creepers.
,, IV.—Diceidæ - - - - - Flower-peckers.
,, V.—Ampelidæ - - - - Chatterers.
,, VI.—Hirundinidæ - - - - Swallows.
,, VII.—Tanagridæ - - - - Tanagers.
,, VIII.—Fringillidæ - - - - Finches.
,, IX.—Icteridæ - - - - - Hang-nests.

SUB-ORDER III.—STURNIFORMES: STARLING-LIKE BIRDS.

Family I.—Ploceidæ - - - - - Weavers.
,, II.—Sturnidæ - - - - - Starlings.
,, III.—Artamidæ - - - - - Wood-swallows.
,, IV.—Alaudidæ - - - - - Larks.

SECTION B.—MESOMYODI: SONGLESS BIRDS.

Family I.—Menuridæ - - - - - Lyre-birds.
,, II.—Pteroptochidæ - - - Bush-wrens.
,, III.—Dendrocolaptidæ - - Spine-tails.
,, IV.—Formicariidæ - - - { American Ant-thrushes.
,, V.—Pittidæ - - - - - { Old-World Ant-thrushes.
,, VI.—Tyrannidæ - - - - Tyrant-birds.
,, VII.—Cotingidæ - - - - American Chatterers.
,, VIII.—Pipridæ - - - - - Manakins.
,, IX.—Eurylæmiidæ - - - Broadbills.
,, X.—Phytotomidæ - - - Plant-cutters.

ORDER IV.—COLUMBÆ: PIGEONS.

ORDER V.—GALLINÆ: GAME-BIRDS.

Family I.—Cracidæ - - - - - Curassows.
,, II.—Opisthocomidæ - - - Hoatzins.
,, III.—Phasianidæ - - - - Pheasants.
,, IV.—Meleagridæ - - - - Turkeys.
,, V.—Tetraonidæ - - - - Grouse.
,, VI.—Pteroclidæ - - - - Sand-grouse.
,, VII.—Turnicidæ - - - - Hemipodes.
,, VIII.—Megapodidæ - - - - Megapodes.

ORDER VI.—GRALLÆ: WADING BIRDS.

Family I.—Rallidæ - - - - - - Rails.
,, II.—Scolopacidæ - - - - Snipes.
,, III.—Charadriidæ - - - - Plovers.
,, IV.—Otididæ - - - - - - Bustards.
,, V.—Gruidæ - - - - - - Cranes.
,, VI.—Psophiidæ - - - - Trumpeters.

ORDER VII.—HERODIONES: HERONS.

Family I.—Ardeidæ - - - - - Herons proper.
,, II.—Ciconiidæ - - - - - Storks.
,, III.—Plataleidæ - - - - Spoonbills.
,, IV.—Phœnicopteridæ - - Flamingoes.

ORDER VIII.—ANSERES: GEESE.

Family I.—Palamedeidæ - - - - Screamers.
,, II.—Anatidæ - - - - - - Ducks.

ORDER IX.—STEGANOPODES: PELICANS.

Family I.—Fregatidæ - - - - - Frigate-birds.
,, II.—Phæthontidæ - - - - Tropic-birds.
,, III.—Pelecanidæ - - - - Pelicans.

ORDER X.—GAVIÆ: SEA-BIRDS.

Family I.—Laridæ - - - - - - Gulls.
,, II.—Procellariidæ - - - - Petrels.

ORDER XI.—PYGOPODES: GREBES.

ORDER XII.—IMPENNES: PENGUINS.

ORDER XIII.—CRYPTURI: TINAMOUS.

DIVISION II.—RATITÆ: STRUTHIOUS BIRDS.

DIVISION III.—SAURURÆ: LIZARD-TAILED BIRDS.

It has been already stated that birds are divisible into three great sections, and attention is now directed to those which have a keel to the sternum, and which are good flyers—the Carinate Birds (CARINATÆ).

CHAPTER III.

DIVISION I.—THE CARINATE BIRDS (CARINATÆ).

THE ACCIPITRINE ORDER—BIRDS OF PREY.

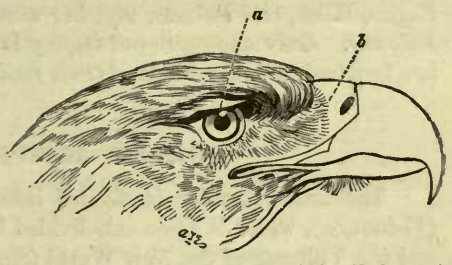
VULTURES AND CARACARAS.

The Birds of Prey—Distinctive Characters—The Cere—How the Birds of Prey are Divided—Difference between a Hawk, an Owl, and an Osprey—The three Sub-orders of the Accipitres—Sub-order FALCONES—Difference between the Vultures of the Old World and the Vultures of the New World—THE OLD WORLD VULTURES—Controversy as to how the Vultures reach their Prey—Waterton on the Faculty of Scent—Mr. Andersson's, Dr. Kirk's, and Canon Tristram's Views in Favour of Sight—THE BLACK VULTURE—THE GRIFFON VULTURE—Its Capacity for Feeding while on the Wing—THE EARED VULTURE—One of the Largest of the Birds of Prey—Whence it gets its Name—THE EGYPTIAN VULTURE—A Foul Feeder—THE NEW WORLD VULTURES—THE CONDOR—Its Appearance—Power of Flight—Habits—THE KING VULTURE—THE TURKEY VULTURE—THE CARACARAS—Distinctive Characters—Habits—THE SECRETARY BIRD—How it attacks Snakes—Habits—Appearance—THE ÇARIAMA.

THE first order of birds to be considered is the birds of prey (*Accipitres*). They are all remarkable for strong and sharply-hooked bills, and most of them have sharp and powerful talons. In the Eagles and Falcons these characters are developed in the highest degree, although many modifications of their structure take place in the order—the Vultures, for instance, and other carrion-feeding birds, not having such a hooked bill as the true Falcons and Eagles, while their feet are larger and more adapted for holding their prey than for striking it down in full career, as the Falcons do. In most of the birds of prey the female is larger than the male, and is much the more powerful bird. This fact is always recognised in falconry, especially in the short-winged Hawks, such as Sparrow-Hawks or Goshawks, whose females are always preferred, as possessing the greater power for holding ground game, such as Rabbits, Hares, &c. The difference in size is not very noticeable in the Vultures, but is unmistakable in the long-legged Sparrow-Hawks, Eagles, and Falcons. The form of the breast-bone, which plays such an important part in the classification of other birds, is a character of less value in the birds of prey, as it varies to a great extent even in those species which, by their habits and general structure, are most closely allied. Another character possessed by these birds is the distinct *cere*, which is present in all, though much hidden by bristles in the Owls: it is a waxy covering to the base of the bill, often hard, but generally fleshy in substance.

Birds of prey are of three kinds: Hawks, Ospreys, and Owls. Under the first name is included every rapacious bird which is not an Osprey or an Owl, and, therefore, the first thing to find

out is—how to tell an Owl from a Hawk. At one time it was supposed that all Owls came out by night and all Hawks by day, and so they were separated into two great divisions, which were called diurnal birds of prey* and nocturnal birds of prey.† Now, however, that the habits of birds are getting better observed, these divisions have to be abandoned as not being entirely true, for there are Owls which are quite at home in the daylight, when they hunt for their food like any other bird of prey, and at least one kind of Hawk is known, whose habit it is to feed on Bats in the evening. This is Andersson's Pern, ‡ a kind of Kite, allied to the Honey-kite of England. It is found only in the Damara Country, in South-western Africa, and in Madagascar. A far better way to distinguish Hawks from Owls is seen in the foot, as the latter have the outer toe reversible—that is to say, they can turn their outer toe backwards or forwards as they please. This is easily observed in the living birds; and any one examining a caged Owl in the Zoological Gardens will see that it sits with its toes in pairs—two in front and two behind. A Hawk cannot do this, all his toes being arranged as in a little perching bird, such as a Sparrow or a Canary, three in front and one behind. Then, again, Owls have no "after-shaft" to the feathers, a structure which most Hawks possess. The "after-shaft" is the small accessory plume, which springs from the under-side of the main feather. In some birds it is very large, in others small. It occurs on the body feathers only, and is never found in the quills or tail feathers (see p. 238). Lastly, in addition to the reversible outer toe, and the absence of an accessory plume or after-shaft, Owls may be distinguished from all other birds of prey, save one, by the proportions of their leg-bones. In the skeleton figured on p. 241 the three principal leg-bones are pointed out; and it is the length which the tarsus bears in proportion to the tibia that is here insisted on. In the Owls the tarsus is only about half the length of the tibia; this is never the case in a Hawk, in which these two bones bear different proportions the one to the other, according to the sub-family. Thus in Sparrow-Hawks and Harriers § the tibia and the tarsus are equal in length. In Eagles and Buzzards, Kites and true Falcons, the tibia is always much longer than the tarsus, but is never double its length, as it is in the Owls. The term "Hawk," which has been employed throughout the foregoing sentences, is intended to apply to every bird of prey excepting the Owls, with the sole exception of the Osprey. The habits of the Osprey are noticed later on, but they may be briefly stated to be similar to those of a Sea-Eagle, its prey consisting entirely of fish, while its plumage and general appearance are also those of an Eagle, so that in many places it is popularly known as the "Fish Hawk," or "Fishing Eagle;" but here the resemblance of the Osprey to the Eagle ends, and in its other characters it is very like an Owl. The tibia is more than double the length of the tarsus, as in the Owls; the feathers of the body have no after-shaft, as in the Owls, and the outer toe is reversible, as in the Owls. Possessing, therefore, as it does, some of the most prominent features of the Eagles, as well as some of the most striking peculiarities of the Owls, the Osprey holds an intermediate position between these two sub-orders of birds.



HEAD AND BILL OF SEA EAGLE. (*After Keulemans.*)
(*a*) bony eye-shelf; (*b*) cere.

The birds of prey, then, may be separated into three sub-orders :—

(*a*). Outer toe *not* reversible; tibia varying in length in proportion to the tarsus, sometimes equal to it, but never double the length of the latter; body feathers *with* an after-shaft or accessory plume. (American Vultures excepted.)

I. Hawks (*Falcones*).‖

(*b*). Outer toe *reversible;* tibia double the length of tarsus; body feathers *without* an after-shaft or accessory plume; plumage compact, as in an Eagle; no facial disk.

II. Ospreys (*Pandiones*).¶

(*c*). Outer toe *reversible;* tibia double the length of tarsus; body feathers *without* an after-shaft; plumage soft and fluffy; a facial disk.

III. Striges;** Owls.

* *Accipitres diurni* of authors. † *Accipitres nocturni* of authors. ‡ *Machœrhamphus Anderssoni.* § *Accipitrinæ*.
‖ *Falco*, a Falcon. ¶ Πανδίων, a Greek mythological name. ** στρίγξ, an Owl.

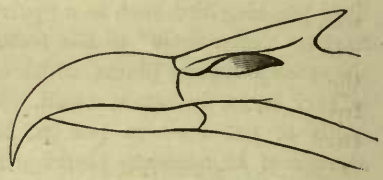
The Falcones, or Hawks, include in their number more kinds of rapacious birds than the other two sub-orders. All the Vultures, the Caracaras, the Harriers, the Sparrow-Hawks, the Buzzards, Eagles, Kites, and Falcons, together numbering some four hundred different species, are classified as *Falcones*. Only one species of Osprey is known, which is found nearly all over the world; and about two hundred different kinds of Owls remain to represent the STRIGES.

ORDER ACCIPITRES.—SUB-ORDER FALCONES.

The first sub-order is divided into two families, the first to be noticed being the Vultures (*Vulturidæ*), which is again sub-divided into two sections, the Vultures of the Old World (*Vulturinæ*) and the Vultures of the New World (*Sarcorhamphinæ*).

THE FIRST SUB-FAMILY OF THE VULTURIDÆ.—THE OLD WORLD VULTURES (*Vulturinæ*).

These Vultures are neither to be recommended for their habits nor for their personal appearance. In fact, in both these respects they are rather repulsive birds, but useful withal in hot climates, where they act as scavengers, and clear away much putrid matter and decaying substances, which but for their intervention would prove most offensive. They are all inhabitants of tropical, or at least of warm, countries; and it is only on rare occasions that they wander into the North of Europe or occur in the British Islands. Both the Old and the New Worlds have their Vultures, but the naturalist has no difficulty in telling at a glance to which hemisphere the bird he is looking at belongs, for all the Vultures of the New World have *a hole through their nose*—or, in other words, want the wall of bone which divides one nostril from the other; in the Vultures of the Old World this bony wall is present so that the nostrils resemble those of other ordinary birds.



BILL OF EGYPTIAN VULTURE, TO SHOW FORM OF NOSTRIL. (*After Keulemans.*)

Besides their perforated nostril, the American Vultures differ from the Old World species in having no after-shaft to the feathers, therein resembling the Owls. This character has led some naturalists to consider the New World Vultures as constituting a separate family, which bears the name of *Cathartidæ;* but although the absence of an after-shaft is a striking feature, yet the habits of the birds so closely resemble those of their Old World cousins, that it seems unnatural to separate them widely in any scheme of classification. The head of a Vulture, whatever locality he may be from, proclaims the nature of the bird at once, as it is always bare of feathers, or nearly so: sometimes a few scattered tufts of down are seen on the head and neck, but never any true feathers, as in the case of the other birds of prey. The Vultures feed on the ground, where they walk with comparative ease, their large feet being fitted for progression on the earth, and their toes not being prehensile or capable of bending to the same extent as in the other Hawks. This formation of the foot prevents them from striking down or snatching their prey, as an Eagle or a Hawk would do; and they do not carry food to their young, but devour the carcase or carrion where it falls, and then feed the nestlings by throwing up food from their crop. They are all birds of powerful flight, and are capable of sustaining a prolonged soar in the air without any apparent motion of the wings.

BILL OF TURKEY VULTURE, TO SHOW THE PERFORATED NOSTRIL.

As to the way in which Vultures discover their prey, the opinion of naturalists has for a long time been divided, and controversy has waxed hot upon the subject, the question being whether the Vulture possesses a more than usually keen sense of sight, or whether his sense of smell is so powerful as to enable him to scent a decaying carcase at a greater distance than other birds can do. The experiments of various travellers seem to prove that both the senses of sight and smell are possessed by the Vulture in no ordinary degree; but the balance of evidence seems to prove that it

is by their keen sight that they generally find their food. Supposing that an animal is wounded, and escapes from the hunter, his course is marked by a Vulture soaring high in the air; another circling far away on the horizon sees the first bird fly down, and follows in his track; and so on, until a large company is feeding on the carcase. This action of the Vultures is well described by Longfellow:—

"Never stoops the soaring Vulture
On his quarry in the desert,
On the sick or wounded Bison,
But another Vulture, watching
From his high aërial look-out,
Sees the downward plunge, and follows;
And a third pursues the second,
Coming from the invisible ether,
First a speck, and then a Vulture,
Till the air is dark with pinions."*

The power of the Vulture's sight was long disputed by the former generation of naturalists, and the celebrated Waterton wrote an article on the "Faculty of Scent in the Vulture,"† to prove that it was more by this means than by sight that the bird was able to discover a carcase. Waterton was well acquainted with Vultures in Demarara and in Southern Spain, and he sums up his argument as follows:—"After the repeated observations I have made in the country where it abounds, I am quite satisfied that it is directed to its food by means of its olfactory nerves coming in contact with putrid effluvium, which rises from corrupted substances through the heavier air. Those are deceived who imagine that this effluvium would always be driven to one quarter in the tropics, where the trade-winds prevail. Often, at the very time that the clouds are driving from the north-east up above, there is a lower current of air coming from the quarter directly opposite. This takes place most frequently during the night-time, in or near the woods; and it often occurs early in the morning, from sunrise till near ten o'clock, when the regular trade-wind begins to blow. Sometimes it is noticed in the evening, after sunset; and now and then during the best part of the day in the rainy season. . . . Vultures, as far as I have been able to observe, do not keep together in a large flock when they are soaring up and down in quest of a tainted current. Now, suppose a Mule has just expired behind a high wall, under the dense foliage of evergreen tropical trees; fifty Vultures, we will say, roost in a tree a mile from this dead Mule. When morning comes, off they go in quest of food. Ten fly, by mere chance, to the wood where the Mule lies, and manage to spy it through the trees; the rest go quite in a different direction. How are the last-mentioned birds to find the Mule? Every minute carries them farther from it. Now reverse the statement; and instead of a Mule nearly dead, let us suppose a Mule in an offensive state of decomposition. I would stake my life upon it that not only the fifty Vultures would be at the carcase next morning, but also that every Vulture in the adjacent forest would manage to get there in time to partake of the repast." It will be seen from the above that Mr. Waterton allowed the keen sight of the Vultures to play, on some occasions, a part in their discovering food. Another observation on this subject is contained in the late Mr. C. J. Andersson's work on the ornithology of South-western Africa. Writing on the Sociable Vulture (*Otogyps auricularis*), he says:—"I believe naturalists are not quite agreed as to whether Vultures hunt by sight, by scent, or by both faculties combined. I have myself no doubt that they employ the one sense as well as the other in finding their prey, though I feel inclined to give sight the preference; and I once had a very striking proof of how they employ their vision in guiding them to carrion—in this instance, however, not so much by the actual sight of the carrion (though the first discovery probably originated in that way) as by another singular contrivance. Early one morning, as I was toiling up the ascent of a somewhat elevated ridge of hills, with the view of obtaining bearings for my travelling map, and before arriving at the summit, I observed several Vultures descending near me: but thinking I had merely disturbed them from their lofty perch, I did not take any particular notice of their appearance, as the event was one of usual occurrence; but on gaining my destination, I found that the birds were not coming merely from the hill summit, but from an indefinite distance on the other side. This circumstance, coupled with the fact that I had wounded a Zebra on the preceding day in the direction towards which the Vultures were winging their way, caused me to pay more attention. The flight of the Vultures was low—at least five hundred to a thousand feet below the summit of the mountain; and on arriving near the base, they would abruptly rise without deviating from their direct course;

* "Song of Hiawatha," Book XIX.

† "Essays on Natural History," 1866, p. 17.

and no sooner was the obstacle in their way thus surmounted than they again depressed their flight. Those Vultures which I saw could not have themselves seen the carrion, but simply hunted in direct sight of one another. There was a numerous arrival; and although I could not always detect the next bird as soon as I had lost sight of the previous one, yet, when at length it did come into view, it never seemed uncertain about its course. Having finished my observations, I descended, and proceeded in the direction which the Vultures had pursued; and after about half an hour's rapid walking, I found, as I anticipated, the carcase of a Zebra, with a numerous company of Vultures busily discussing it."*

Dr. Kirk, the companion of Livingstone, in his paper on the "Birds of the Zambesi Region of Eastern Tropical Africa,"† says that to the inexperienced hunter the Griffon is "a great annoyance. If game be left for an hour in the open plain while the men come to carry it off, the birds will descend, and in a very short time completely devour it. This is not so if it be covered over with a little grass or with branches, clearly proving that sight alone is the sense by which the birds discover their prey. If part of the animal be exposed it matters not—probably owing to its being mistaken for one asleep; nor does the presence of blood seem to guide the birds if the carcase be concealed from view."

Lastly, to quote from Canon Tristram's interesting essay on the "Ornithology of the Sahara:"‡ "As, happily for the traveller, Camels do not die every day under the weight of their water-skins, the Griffon does not habitually visit the desert. Still, he occasionally gives it a passing call, though, if his meal be deposited near an oasis, he is usually forestalled by the Hyæna ('Dubba,' Arab.), who lurks in the 'weds.' On one occasion a Camel in our caravan having become footsore had to be slaughtered on the spot. Our attendants selected the tenderest morsels for 'kouskous,' the Arab broth; and it was not until the next morning that a Vulture scented, or rather descried, his prey. That the Vulture uses the organ of sight rather than that of smell, seems to be certain from the immense height at which he soars and gyrates in the air. In this instance one solitary bird descended, and half an hour afterwards was joined by a second. A short time elapsed, and the Nubian Vulture (*Otogyps nubicus*) appeared, self-invited, at the feast; and before the bones were left to the Hyæna no less than nine Griffons and two Nubians had broken their fast. I should hesitate to assert that they had satisfied their appetites. I have observed the same regular succession of diners out on other occasions. May we not conjecture that the process is as follows? The Griffon who first descries his quarry descends from his elevation at once; another, sweeping the horizon at a still greater distance, observes his neighbour's movements and follows his course; a third, still farther removed, follows the flight of the second; he is traced by another; and so a perpetual succession is kept up as long as a morsel of flesh remains over which to consort. I can conceive no other way of accounting for the numbers of Vultures which in the course of a few hours will gather over a carcase, when previously the horizon might have been scanned in vain for more than one, or at the most two, in sight. Does not this explain the immense number of Vultures who were congregated in the Crimea during the siege of Sebastopol, where the bird was comparatively scarce before? May not this habit of watching the movements of their neighbours have collected the whole race from the Caucasus and Asia Minor to enjoy so unwonted an abundance? The Arabs believe that the Vultures from all North Africa were gathered to feed on Russian Horses in the Crimea, and declare that during the war very few 'Nissr' were to be seen in their accustomed haunts."

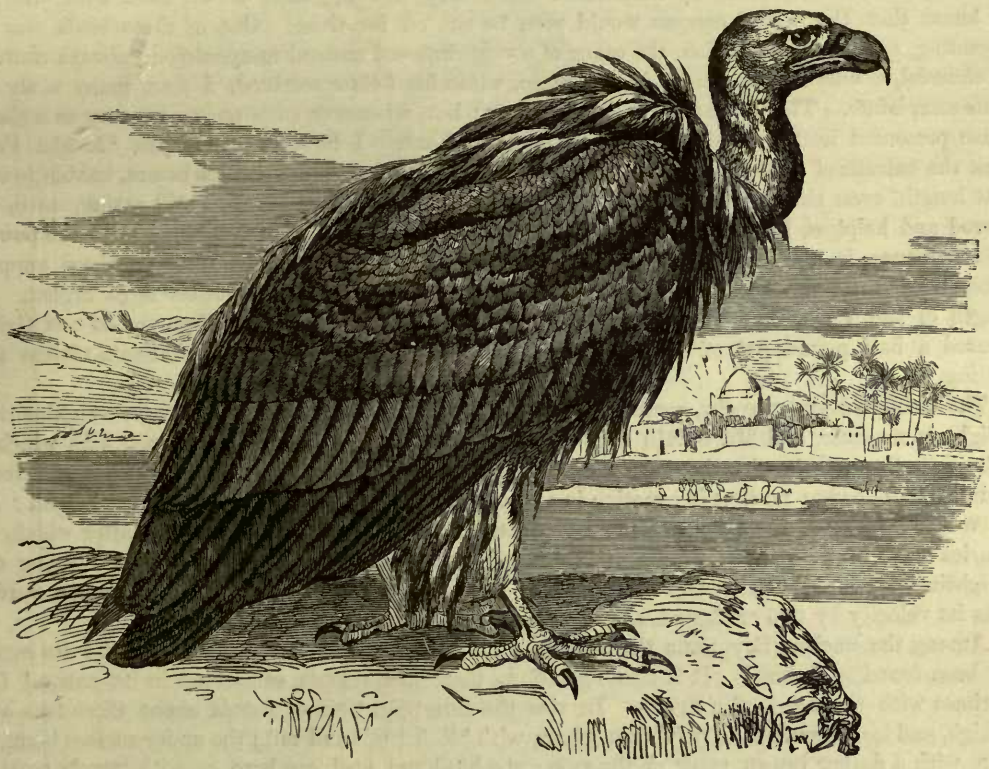
The above extracts from authentic works have been made at some length, as exhibiting the general habits of the Vultures. It remains now to notice some of the most striking forms of these birds.

THE BLACK VULTURE §

This is an inhabitant of Southern Europe, whence it extends on both sides of the Mediterranean to North-western India, where it is a cold weather visitant, and even to China. In its habits this bird is rather unsociable, and keeps more to the wooded districts, seldom venturing into the open country, except when attracted by the presence of some carcase, on which it feasts in company with the Griffon Vulture. It breeds on trees, constructing a large bulky nest, and only selects a rock for its

* "Notes on the Birds of Damara Land and the adjacent countries of South-west Africa," 1872, p. 3.
† 1864, p. 307. ‡ 1859, p. 277. § *Vultur monachus.*

breeding home when there are no trees to be found in the neighbourhood. It lays one egg, of a richly mottled red colour, two eggs being an extremely rare occurrence. In appearance they are very like those of the Golden Eagle. A story is told of the rescue by a pair of old birds of their young ones, which were in danger from the felling of the tree on which the nest was situated. It is thus related by Count von Tshusi Schmidthofen :—"The royal forester, A. Fikker, found in 1860, on the top of a giant beech in the valley of Dobrabach, in the Sinnaer district, the nest of this Vulture. When the young birds were large enough to be able to save themselves as the tree fell, orders were given to cut the beech down. The wood-cutters had worked at the tree some time, when the old birds appeared, uttering loud cries, and suddenly pounced on the nest, caught hold of the young ones



GRIFFON VULTURE.

in their claws and disappeared like lightning, carrying off the young (who loudly complained of the unusual mode of locomotion) before the gaze of the astonished spectators."

The Black Vulture measures three feet and a half in length, and is entirely black, the bare places on the head and neck being of a livid flesh colour when the bird is alive.

THE GRIFFON VULTURE.*

The Griffon, or Fulvous Vulture (so called from its colour), is found all over Southern Europe, and occurs occasionally at different points in Central Europe, having once been taken in the British islands off Cork Harbour; it therefore figures in the list of British birds. It ranges all over North-eastern Africa, and extends eastwards into Turkestan, Central Asia, and North-western India. As it goes eastwards the Griffon becomes a more rufous bird, and is by some naturalists considered to be a different species. In the British Museum is a very interesting specimen of this Vulture, collected by Major Denham in Bornou during his travels across Africa, being one of the comparatively few birds that have been brought from Central Africa, about the ornithology of which we do not even yet know

* *Gyps fulvus.*

much. Like other Vultures, the Griffon feeds on carrion, but is also stated to frequent the sea-shore in search of Crustacea and dead fish; while the South African Griffon is said to feed on Locusts and small Tortoises, the latter of which it swallows whole.*

This bird's capacity for feeding is illustrated in a most amusing anecdote of Canon Tristram's:—"For some months we possessed two Griffons taken from the nest, who at length arrived safely in England. They never attempted to leave us, differing in this respect from our Lämmergeiers, but remained contentedly about the tents or perched on the backs of the baggage-camels *en route*. They took a peculiar interest in taxidermy, scrutinising, head on one side, the whole operation of bird-skinning, and perfectly aware of the moment when a morsel would be ready, exhibiting a more than ordinary excitement when they saw the skin drawn back over the head, and knew that the whole carcase would soon be cut off for them. One of these birds was of a desponding, querulous disposition, the other of a very different natural temperament, always contented and cheerful, a universal favourite in the camp, while his fellow received, I fear, many a sly kick for his complaints. They were able to fast for days; but, whenever such an opportunity as a Camel's carcase presented itself, would be revenged on their Lent. I have seen our pet, 'Musha Pasha,' attack the entrails of a Camel, and, as his crop became distended, sink upon his breast, unable to stand, till at length, even this position being too much for him, he lay on his side, still eating, until, overpowered and helpless, he fell asleep. This enormous capacity for food, combined with the power of long abstinence, is a wonderful provision of creative wisdom for carrion-feeders, whose supply is so uncertain, while the necessity for the immediate removal of offensive matter is so urgent. The strength of the Vulture's stomach is equal to its capacity, for on one occasion one of our Griffons devoured a half pound pot of arsenical soap, with no further inconvenience than a violent fit of vomiting."

The Griffon nests on rocks, sometimes several building in company in the same neighbourhood. Its flight is majestic, and Mr. Salvin says that it is a fine sight to watch the ease with which the Griffon sails through the air; the apparently effortless extension of the wing seems amply sufficient to sustain its huge body; no flapping motion is necessary to enable it to mount to a great height. It is only on leaving a rock that a few strokes are requisite to attain the necessary impulse, after which, with primaries bent upwards by the force of the air, it performs its stately evolutions by soaring only. In alighting, the bird drops its legs some distance from the rock, and, sailing to within a few yards, it checks its velocity by two or three heavy strokes of the wing.

Among the ancient Egyptians the Griffon appears to have been a sacred bird, and its remains have been found embalmed. It is also figured on their monuments, sometimes in its natural form, sometimes with the head of a Snake. In size the European Griffon stands about three feet and a half high, and is of a general ashy fulvous colour, with black quills and tail; the under surface is creamy-brown, with a darker brown mark on the crop; the head and neck are bare, or with loosely scattered tufts of white down; and round the neck there is a white ruff.

Besides the Griffon Vulture of Europe there are four others, which seem to be distinct species, the Himalayan Griffon, the South African Griffon, Rüppell's Griffon from Abyssinia, and the Long-billed Griffon from India. In addition to these there are the two White-backed Griffon Vultures, which have only fourteen tail-feathers, and belong to the genus *Pseudogyps*.

THE EARED VULTURE (*Otogyps* † *auricularis* ‡).

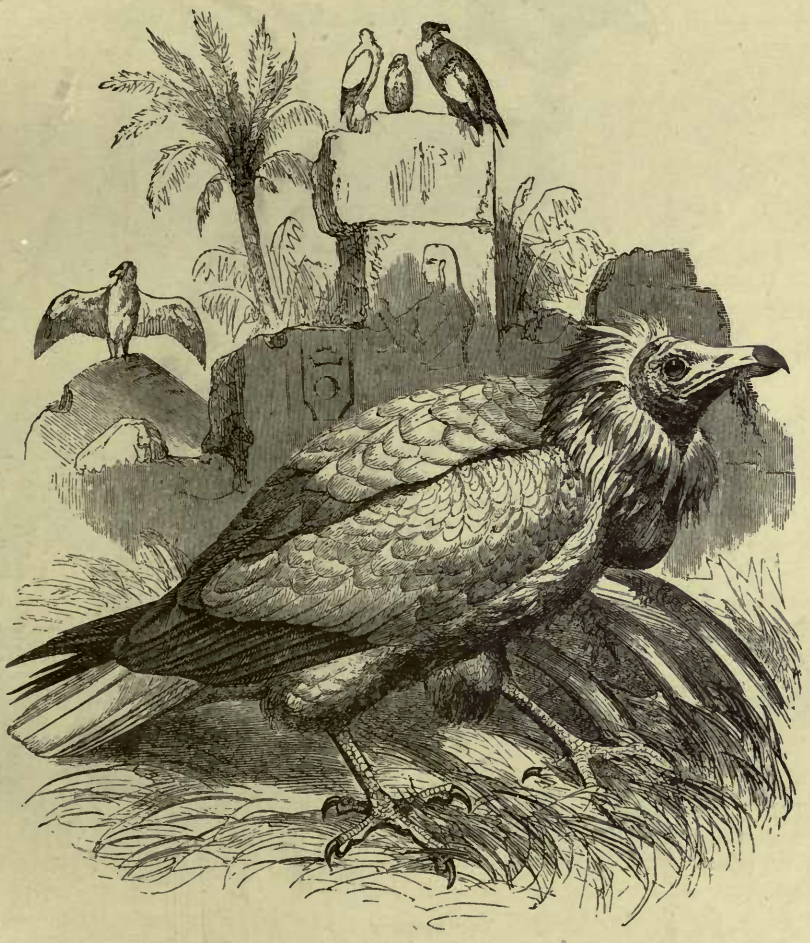
This is one of the largest species of the birds of prey found in the Old World, being exceeded in size only by the Great Condor of the Andes. It is an inhabitant of Africa, being plentifully spread over the southern portion of the Continent, and also occurring in North-Eastern Africa, whence it ranges in small numbers to Lower Nubia and the Sahara, and has even been said to occur accidentally in Europe. It has received the name of Eared Vulture on account of the folds of skin on the sides of the neck, which are found only in one other species, the Indian Vulture (*O. calvus*). These two kinds of Eared Vultures appear to play the part of the King Vulture of South America,

* J. H. Gurney: "Descriptive Catalogue of the Raptorial Birds in the Norfolk and Norwich Museum."

† οὖς, ὠτός, an ear; γύψ, a vulture. ‡ *Auricularis*, having ears.

the smaller Vultures, such as the *Neophrons*, always giving place to them, and allowing them to finish their feast before venturing to approach.

The Egyptian Vulture (*Neophron* percnopterus*†) is also familiarly known as Pharaoh's Chicken. It is a small bird about two feet and a half in length, white in plumage, with black wings. A great part of the face is bare and of a yellow colour. The young birds are brown. In Europe the Egyptian Vulture is a migratory bird, but it breeds in many localities in the Mediterranean region, and has even occurred once or twice on the shores of the British islands. In winter it takes itself to the Cape



EGYPTIAN VULTURE.

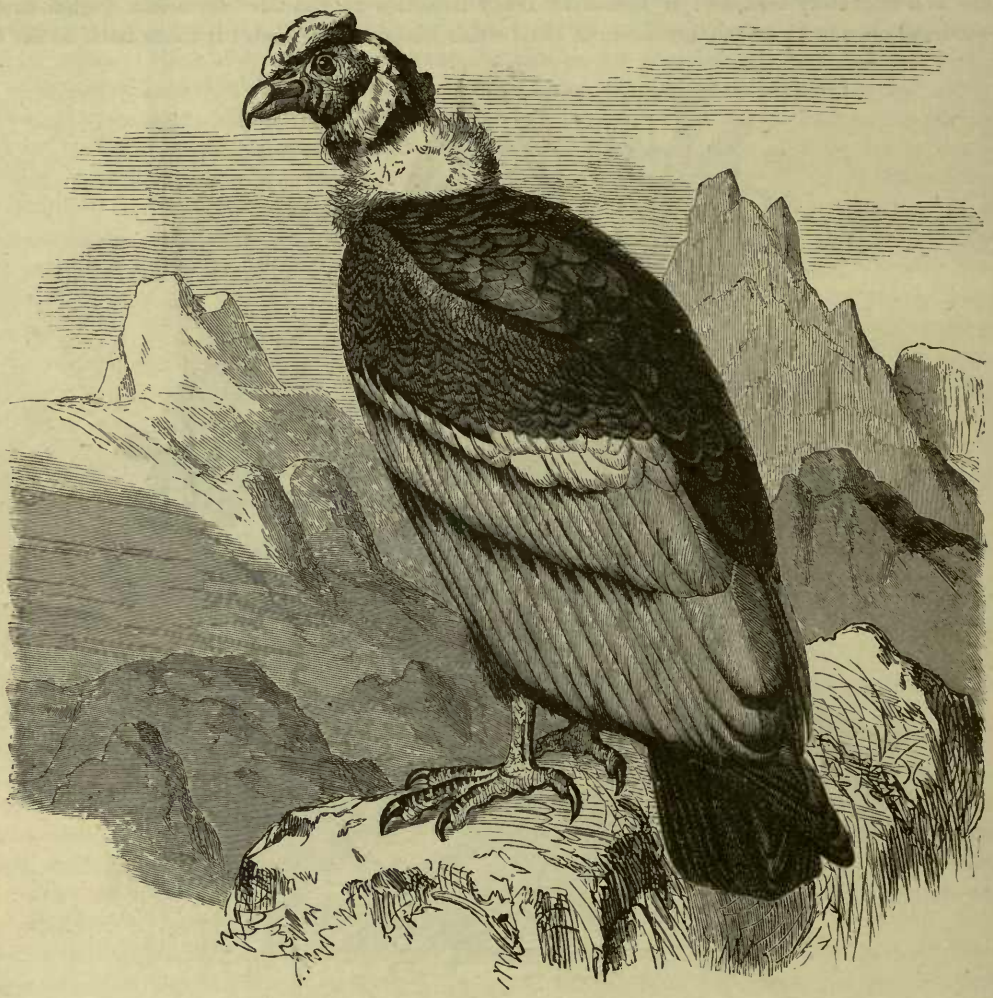
of Good Hope. It is much valued in certain places as a scavenger, as it devours excrementary matter, but Mr. Gurney states that its food also consists of carrion of various descriptions, and in default of such food it occasionally preys upon rats, field mice, small lizards, snakes, insects, and even earthworms. Colonel Irby observes that it is probably the foulest-feeding bird that lives, and that it is very omnivorous, devouring any animal substance, even all sorts of excrement; nothing comes amiss to it, and he has sometimes seen them feeding on the sea-shore on dead fish thrown up by the tide. The same gentleman‡ says that on their migrations they pass Gibraltar, which is one of their lines of passage, about the end of February, and they breed in the neighbourhood of that place, beginning to lay about the 1st of April. The nest is composed of a few dead sticks, always lined with wool, rags,

* A mythological name.

† περκνός, dark-coloured; πτερόν, a wing; so called from the colour of its wings.

‡ "Ornithology of the Strait of Gibraltar," p. 31.

or rubbish ; and Colonel Irby states that he found about a pound of tow in one nest, and the sleeve of an old coat ; while another observer says that on a foundation of branches Pharaoh's Hen heaps rags, patches, old slippers, and whole basketfuls of camels' hair and wool for the comfort of its offspring. The Egyptians frequently represented this species on their monuments, but do not appear to have attached any particular significance to it.



CONDOR.

In India the place of the present species is taken by the Indian Scavenger Vulture (*Neophron ginginianus*), and in Africa the Pileated Vulture (*N. pileatus*), an entirely brown bird, occurs nearly all over the continent.

THE SECOND SUB-FAMILY OF THE VULTURIDÆ.—THE AMERICAN VULTURES (*Sarcorhamphinæ*).

THE CONDOR (*Sarcorhamphus* * *gryphus* †).

As before mentioned, all the American Vultures can be readily distinguished by the perforation of their nostrils. The Condor is a very unmistakable species, being the largest of all the Vultures, and the male has a large comb on the head which is not developed in the female. The hind toe also is

* σάρξ, flesh ; ῥάμφος, a bill ; so called on account of the fleshy wattles on the base of the bill.
† *Gryphus*, a mythological name, a Griffon.

extremely small, scarcely touching the earth, and on this account the foot is less prehensile than in any other Vulture. The home of this magnificent bird is the chain of the Andes in South America, and the neighbouring countries to the west, and it is found inhabiting these mountains from Ecuador and Colombia, down to the Strait of Magellan, and again extending on the east coast as far as the mouth of the Rio Negro in Patagonia. It bears confinement well, examples being generally to be seen living in the Zoological Gardens; and some idea of the extent of wing in the Condor can occasionally be obtained when the birds are sunning themselves on their perch. The expanse in large individuals is said to reach as much as eight or nine feet. All observers agree that when seen in a wild state the flight of the Condor is truly majestic, and it is capable of ascending to an immense height, at which a man could not breathe on account of the rarefaction of the air, a state of things which does not seem to affect the Condor, who is often lost to sight amidst the clouds. The most exaggerated stories of the strength and prowess of this Vulture were circulated by the old authors, and it was even said to attack full-grown oxen. The careful observations, however, of recent travellers, have dispelled many of the fabulous stories respecting it, and it is now a well ascertained fact that the Condor does not attack full-grown animals of any size, but will devour newly-born and helpless offspring, and several of them will unite to kill the mother should she appear in a weak and sickly condition. The supposed habit, attributed to these birds, of carrying off prey in their feet, is disproved by the weakness of the last-named organs, and their utter incapacity for grasping anything: in fact the feet play a very insignificant part in the bird's economy, the powerful bill being the chief factor in tearing a carcase to pieces. The Condor measures about three feet and a half in length, the closed wing being about twenty-nine inches. The general colour of the bird is black, the secondary quills and most of the wing-coverts being externally grey. Round the neck is a ruff of soft white down. The bare parts of the head and neck are not remarkable for any bright colour, but are blackish with traces of livid flesh colour here and there. That the Condor lays sometimes in confinement is shown by a specimen in the British Museum, which was hatched by a common hen, who sat on the egg for six weeks and two days. The nestlings are usually covered with white down.

THE KING VULTURE (*Cathartes* papa*†).

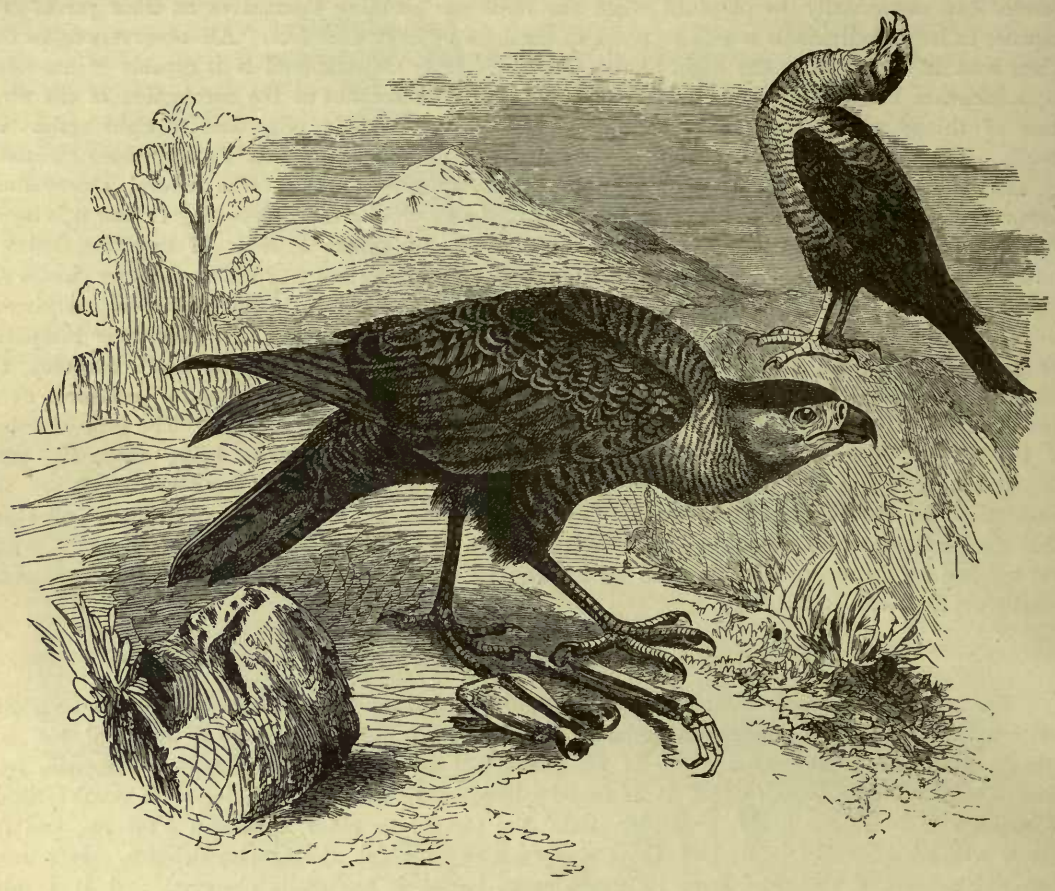
This is by far the handsomest of the whole family, its head and neck being covered with caruncles, which in life are orange, purple, and crimson in colour; the general plumage of the bird, too, is a delicate fawn or cream colour. It is an inhabitant of Central and Southern America, from Mexico southwards to Brazil, where it is found a little below the twentieth degree of south latitude. It appears to be rather a cleaner feeder than the Condor or other American Vultures, and frequents wooded countries instead of those rocky places in which the Condor delights. It is rarer than the last-named bird, and from its forest-loving habits is less easily observed, and it is altogether a more active and lively species. It is shy and suspicious, and is most difficult to obtain, from its habit of sitting on the tops of trees, whence it scans with ease the country around. On this account it is seldom shot, and D'Orbigny, from whose works much of the above information is derived, says that it is only captured by attracting it to a carcase, and then shooting it from an ambush. Another mode of capture, which he says is followed by the natives of Santa Cruz de la Sierra,‡ is by finding out the tree on which the King Vulture roosts, and to which it returns night after night, and then to climb up and capture the bird with gloved hands. The same observer says that it is not from any innate respect, but from fear of its powerful bill, that the Turkey Vultures pay such deference to this present bird, not venturing to commence their repast until he is satisfied, whereby he is popularly known as the "King" of the Vultures.

THE TURKEY VULTURE (*Rhinogryphus*§ *aura*).

This is an inhabitant of North America, whence it ranges throughout Central America and the West Indian Islands down the Andean chain to the Strait of Magellan. Their habits vary somewhat

* καθαρτής, a scavenger. † Papa, a pope. ‡ D'Orbigny, "Voyage dans l'Amérique Meridionale," p. 30.
§ ῥίν (ῥίς), ῥινός, a nose; *gryphus*, as before, a Griffon, or Vulture; so called on account of its peculiar perforated nose.

with locality, for whereas in the Southern United States they act as scavengers in the towns, in Guatemala and other places in Central America they are not seen in flocks, but occur in pairs only in the forests. As in the case of the other Vultures, their food consists of carrion, and they are found in large numbers in deserts, where they obtain an ample supply of food in the animals which perish. The Turkey Vulture is about two feet and a half in length. The plumage is black with a purplish gloss, and in life the bare head and neck are of a bright red colour, which soon fades after death.



BRAZILIAN CARACARA.

FAMILY FALCONIDÆ.—THE FALCON-LIKE HAWKS.

THE FIRST SUB-FAMILY.—THE CARACARAS (*Polyborinæ*).

All the members of this sub-family are more or less Vulturine in their habits and appearance, and many of them are carrion feeders. The name "Caracara" with which these birds are here designated is of Brazilian origin, and all the species included under the present heading are inhabitants of Central and Southern America, with the exception of the Secretary Bird of Africa. They all seem to be at home on the ground, and they differ from all other birds of prey in having a membrane which joins the base of the two outer toes to the middle one, a feature which is doubtless useful to the birds when wallowing in the marshy ground, which many of them frequent in quest of frogs, &c. The Southern Caracaras (*Ibycter australis*) are said to run with extreme quickness, putting out one leg before the other, and stretching forward their bodies very much like Pheasants. Mr. Darwin, who became acquainted with these birds during his voyage in the *Beagle*, says that their flesh is good to eat, and he gives a very interesting

account of the habits of the Southern Caracara in the Falkland Islands, where they were extraordinarily tame and very mischievous, frequenting the neighbourhood of the houses to pick up all kinds of offal. If a beast were killed they congregated from all quarters like so many Vultures, and they did not hesitate to attack and capture wounded birds, on one occasion pouncing on a Dog which was lying asleep. They would also carry off miscellaneous articles which were lying on the ground. "A large black glazed hat was carried nearly a mile, as were a pair of heavy balls, used in catching wild cattle. Mr. Usborne experienced during the survey a severe loss in a small Kater's compass, in a red morocco case, which was never recovered." According also to Mr. Darwin, these birds were quarrelsome and extremely passionate, and it was curious to behold them, when impatient, tearing up the grass with their bills, from rage. It may be owing to their strong feelings, as described by the last-named naturalist, that the colour of the face changes in the Brazilian Caracara, concerning which a somewhat amusing incident may be related. There arrived from Patagonia at the Zoological Gardens two Caracaras, which were white instead of brown, like the Brazilian species (*Polyborus tharus*), and the question which troubled naturalists was, whether these Patagonian birds were a distinct species, or whether they were simply a white variety of the ordinary Brazilian bird. The latter had the bare skin of the face lemon-yellow, whereas the white birds had this part purple, and this was looked upon as one sign of their belonging to a distinct species. But one memorable day an ornithologist went up to describe the new arrivals, and to bestow on them a name, which should mark the character of the purple face. No doubt existed in his mind, for the white birds had now lived for a whole year in the Gardens, and were still white and had a purple visage, but, happening to turn his head away for one moment, he was not a little surprised, on looking back at his supposed new species, to find that the facial character had disappeared, and that the bird's visage was now yellow. At the same moment the face of one of the Brazilian birds in the adjoining den had turned red, and hence it became clear that the Caracaras can change the colour of the bare face at will, and that the lighter-coloured specimen was only an albino after all! Besides the Caracaras, at least one other species of bird of prey changes colour in a somewhat similar way—the Bateleur Eagle,* which, if irritated, flushes up to the roots of its feathers, and its bare face, which is usually scarlet, becomes a deep blood-red or crimson. In the case of the latter bird the change of colour is visible not only in the visage but in the feet also, which likewise acquire a darker red than before.

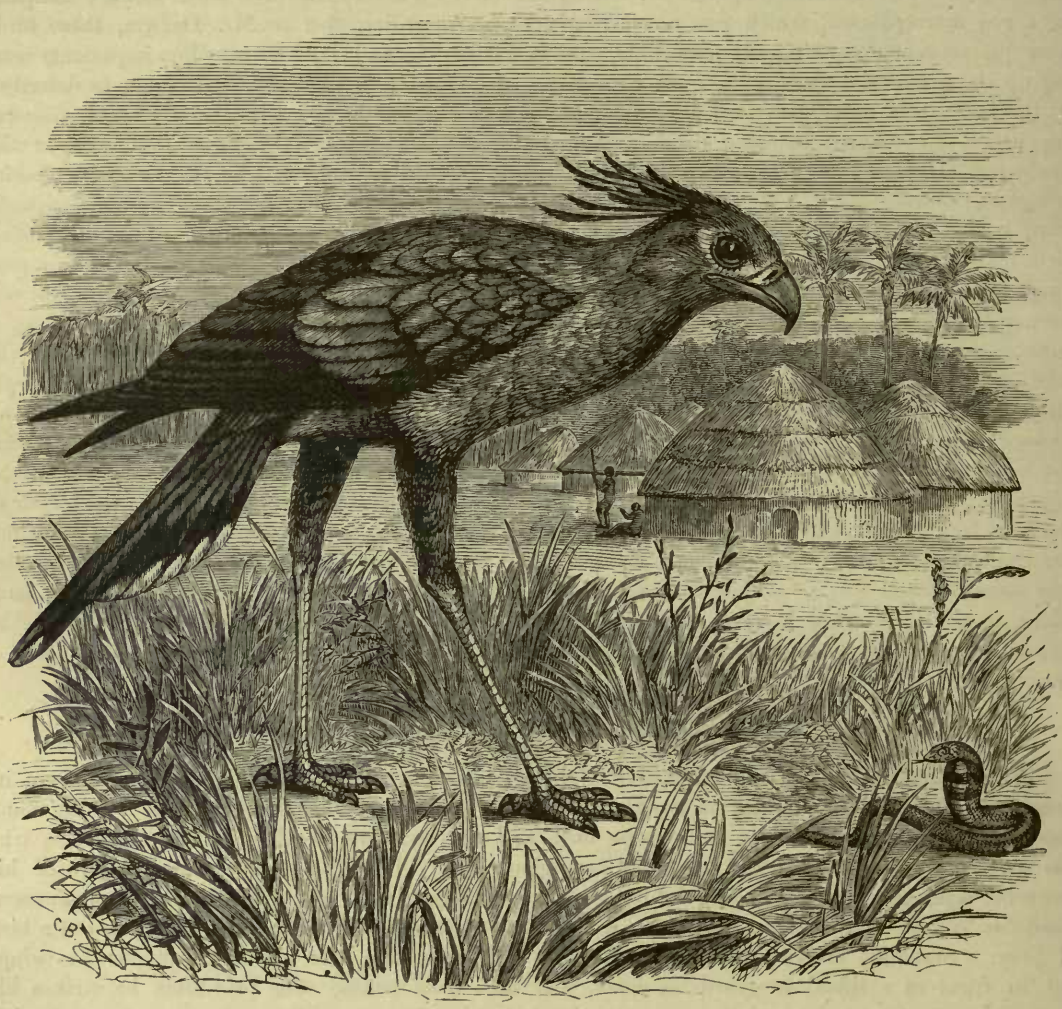
THE SECRETARY BIRD (*Serpentarius*† *secretarius*‡).

This is the only African representative of the Caracaras, or web-footed birds of prey, and from its general look and from its habits, no less than from some peculiar anatomical characters, it is by many good authorities considered to be a game bird, and not a Hawk at all. No one, however, who has seen a Secretary kill a Rat, and the prodigious force with which, by repeated blows of his powerful legs, sometimes springing into the air and bringing both feet down at the same moment upon his victim, he quickly reduces it to a shapeless pulp, would consider him anything but a bird of prey. Standing before a Cobra which rises to attack him, the Secretary spreads his wings out in front as a shield to guard his body, and then from behind this protection he strikes his enemy down. On account of their prowess in destroying venomous Serpents, they are protected with care by both the European and Native Governments in South Africa, and in the Cape Colony a penalty is inflicted upon any one who ventures to kill one of these useful birds. Sometimes the Secretary does not win in the fight with the Snake, for a good observer has stated that on one occasion he saw a bird suddenly leave off fighting and run to a pool of water, where he fell down dead. If the Snake bites a feather, the bird immediately pulls it out, but in the above instance the reptile had drawn blood from the point of the pinion. It is somewhat remarkable that the Secretary should have such striking power in his legs, as they are long and slender for the size of the bird, and are so brittle that it is said that, if suddenly started into a quick run, their legs will snap. The Secretary Bird is a most voracious feeder, devouring Rats, Lizards, Locusts, Snakes, Tortoises, &c., and Levaillant states that he took from the stomach of one of these birds three Serpents as long as his arm

* *Helotarsus ecaudatus.* † *Serpentarius*, a devourer of Serpents. ‡ *Secretarius*, a secretary.

and an inch in thickness, eleven Lizards of seven or eight inches in length, and twenty-one small Tortoises of about two inches in diameter, besides a large quantity of Grasshoppers or Locusts, and other insects.

A spirited and truthful account of the habits of the Secretary was published in 1856 by the late M. Jules Verreaux, who spent upwards of fifteen years in South Africa engaged in a study of the natural history of that part of the world, and a few extracts from this paper cannot be resisted.*



SECRETARY BIRD.

"As Nature exhibits foresight in all that she does, she has given to each animal its means of preservation. Thus the Secretary Bird has been modelled on a plan appropriate to its mode of life; and it is therefore for this purpose that, owing to the length of its legs and tarsi, its piercing eye is able to discover at a long distance the prey which, in anticipation of its appearance, is stretched on the sand or amongst the thick grass. The elegant and majestic form of the bird becomes now even more graceful; it now brings into action all its cunning in order to surprise the Snake which it is going to attack; therefore it approaches with the greatest caution. The elevation of the feathers of the neck and back of the head shows when the moment for attack has arrived. It throws itself with such force on the reptile that very often the latter does not survive the first blow. But if the bird does not succeed,

* *Proceedings of the Zoological Society*, 1856, p. 348.

and the enraged Snake draws itself up and expands, at the same time, the skin of its neck, as is the way with the more dangerous Serpents, the bird is forced to retreat, and takes a spring backwards, waiting to seize a favourable moment for recommencing the attack. Raising itself, the furious reptile moves its tongue with the quickness of lightning, and gives forth the most vehement hisses, which keep back the enemy and seem to force some respect from it: but the bird, whose courage redoubles in the same ratio that the difficulties increase, opens out its wings, and, returning to the charge, assails the reptile afresh with blows from its terrible feet, such as no one would believe, and which are not long in putting the Snake *hors de combat.* We have, however, sometimes seen the Snakes launch themselves on the Secretary, but, either by opening its wings, whose long primaries serve it as a kind of shield, or by jumping backwards or on one side, the bird is certain to parry the attack of its antagonist, who at last, overcome by fatigue, falls at full length on the ground. The moment is seized by the Secretary to redouble its massive blows, which, by dislocating the vertebral column, soon cause the reptile to give up the ghost. It is then that the victorious Hawk darts like an arrow, and placing its foot on the Serpent's neck, just at the back of the head, commences to swallow it, which it does by beginning at the tail first. Nor is this a long operation, even with reptiles five or six feet in length and more than four inches in diameter; and as soon as it arrives at the head it completely smashes the skull by several blows of its bill before swallowing it."

"Both sexes work at the construction of the nest, which is always placed on the summit of a high dense bush, more often a mimosa. It is added to each year, and it is easy to see the age of a nest by the number of fresh layers which have been added year by year. The young birds remain for six months before leaving the nest, their legs not being strong enough to support the weight of the body. During the whole of this time they are fed with great assiduity by both parents."

The Secretary Bird stands more than four feet high, when fully grown. The general colour of the plumage is grey, with black quills; the lower back and rump are black, the upper tail-coverts white; the tail is grey, tipped with white, and crossed with two black bands; below, the colour is ashy-white, the thighs and abdomen black. From the hinder part of the crown and occiput springs an elegant crest of plumes, which the bird can raise or depress at will; they are either entirely black, or grey with a black tip. It is from these long plumes that the bird has got the name of the Secretary, from some fancied resemblance in the bird's head to the quills which a secretary places behind his ear.

In America, the Secretary is represented by the Çariama (*Çariama cristata*), a bird which looks so like a game bird that, as we have said, many ornithologists place both it and the Secretary among the Gallinaceous birds, and not among the Hawks. From a consideration of its anatomy, however, both Professor Parker and Professor Sundevall determined that the Çariama is an accipitrine bird, though of a very aberrant form. Those who differ from them admit that where the Secretary is placed in the natural system the Çariama must also be located, and no one who has studied the habits of the former, either in a wild state or in captivity, can doubt for a moment that it is a veritable bird of prey, and so it follows that the Bustard-like Çariama must also be included in the same order.

CHAPTER IV.

THE LONG-LEGGED HAWKS AND BUZZARDS.

THE BANDED GYMNOGENE—Habits—Its Movable Tarsi—THE HARRIERS—Distinctive Features—THE MARSH HARRIER—Habits—Its Thievish Propensities—THE HARRIER-HAWKS—Colonel Greyson's Account of their Habits—THE CHANTING GOSHAWKS—Why so Called—Habits—THE TRUE GOSHAWKS—Distinctive Characters—THE GOSHAWK—Distribution—In Pursuit of its Prey—Appearance—THE SPARROW-HAWKS—Distinctive Characters—THE COMMON SPARROW-HAWK—Habits—Appearance—THE BUZZARDS—Their Tarsus—THE COMMON BUZZARD—Where Found—How it might be turned to Account—Food—Its Migrations—Habits—Appearance—THE HARPY.

THE SECOND SUB-FAMILY OF THE FALCONIDÆ.—THE LONG-LEGGED HAWKS (*Accipitrinæ*).

ALL the Hawks included under this heading are remarkable for their long legs, in which the tibial bone and the tarsus are about equal in length. In all the other Hawks, Eagles, Kites, Buzzards, and Falcons, the tibia is always longer than the tarsus.

The Long-legged Hawks are not such powerful birds of prey as the Eagles or Falcons, and do not possess, as a rule, the same dash and courage in pursuing their quarry, many of them feeding on a low kind of diet, and being robbers of eggs and destroyers of young birds. The birds of prey belonging to this sub-family are—1. The Gymnogenes; 2. The Harriers; 3. The Goshawks; 4. The Sparrow-Hawks.

THE BANDED GYMNOGENE* (*Polyboroides*† *typicus*).

From its general appearance, especially in its naked yellow face, this remarkable Hawk is considered to be a close ally of the Secretary Bird; but the proportions of its legs and its habits proclaim it to be nearly related to the Harriers. Two kinds of Gymnogenes are known, one inhabiting Africa, and the other being found in Madagascar. The food of the present species appears to consist of Frogs and Lizards, and at times it walks over the ground which has been recently burnt, in pursuit of insects and small reptiles; at other times it will sit for a long time on stumps by pools of water, watching for Frogs, which in such situations form its favourite food. The Gymnogenes are remarkable in the class of birds for being able to put their leg "out of joint" at will (that is to say, they can bend the tarsus backwards just as they please); and this is a fact which may be accepted as a certainty, since its truth has been tested by many trusty and independent observers. One of these, the late M. Jules Verreaux, states that the tarsi are movable at the "knee"-joint toward the front from behind, a provision which, from the facility it affords the bird for drawing up Frogs out of the marsh-holes by means of its talons, is of no little service to it. The exceedingly compressed toes of this species also enable it to introduce its long tarsi into the narrow crevices of the rocks. He saw it twist and turn its legs in all directions in capturing its prey in marshy places. Mr. Thomas Ayres also says that "the legs of this bird bend backward at the knee in an extraordinary manner, very much as if they were out of joint."

The Banded Gymnogene is nearly twenty-four inches in length, and is of a light grey colour, with black wings, the secondaries being grey like the back, with a black band before the tip; the lower back is white barred with black; the tail black with a white tip and a white bar across the middle; the throat and chest are grey like the back, and the rest of the under surface is white barred with black. The cere and bare space round the eye are yellow when the bird is alive.

THE HARRIERS (*Circus*).

All the Harriers have a facial disc as in the Owls, though not so distinct as in the latter group of birds. In both, however, the disc is formed by a ruff of soft, close-set plumes, which encircle the face; and hence in most classifications the Harriers have been considered as being closely allied to the Owls, on account of their having this "facial disc." Their structure and habits, however, entirely do away with the idea of there being any real affinity between these two groups of accipitrine birds.

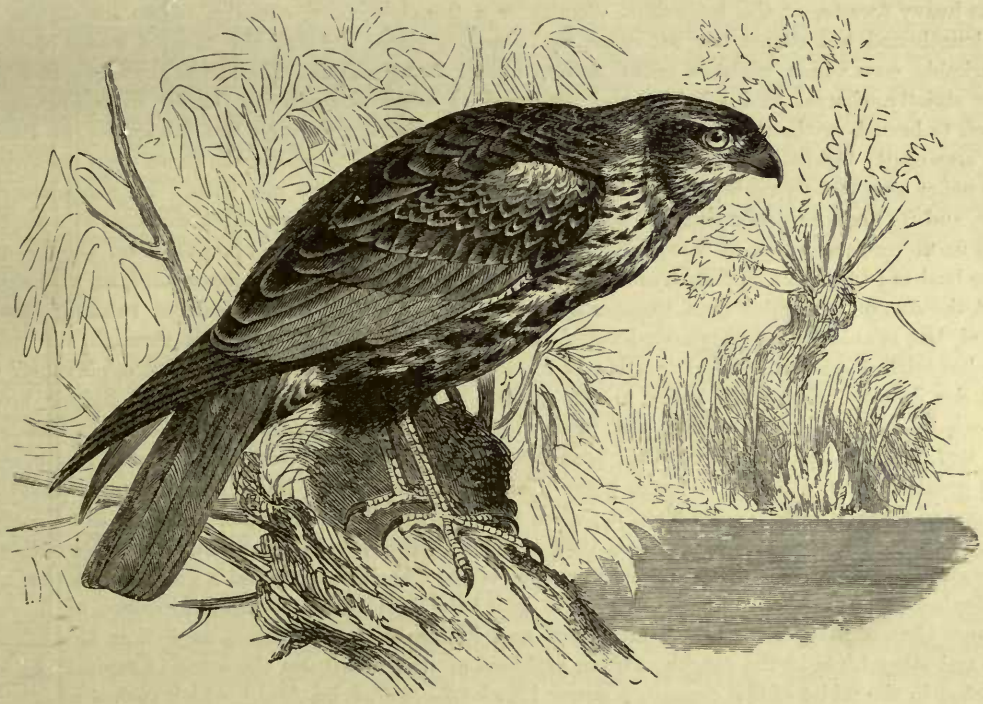
Before the draining of the fens in England, Harriers were by no means uncommon in certain localities; but they are becoming rarer year by year, as each favourite haunt passes from them under the dominion of the agriculturist. Three kinds were found in England, of which the Hen Harrier (*Circus cyaneus*) was the rarest; Montagu's Harrier (*C. pygargus*) was the most plentiful and the most widely distributed; and the Marsh Harrier, or Moor Buzzard (*C. æruginosus*), the most powerful. This is the species which has held its own best, as it is still found breeding in some few places in the United Kingdom. The habits of all the Harriers are very similar, and the genus Circus is probably—with the exception of the Peregrine Falcons—the most universally distributed of any Raptorial birds, for there is scarcely any part of the world where a Harrier is not found.

THE MARSH HARRIER (*Circus æruginosus*).

This is an inhabitant of the Old World, where it enjoys a wide range. It is one of the greatest robbers of eggs and young birds, being, in countries where it is still plentiful, a great nuisance to the sportsman, as, says Colonel Irby, "slowly hunting along in front, it puts up every Snipe and Duck

* Gymnogene: from two Greek words (γυμνός, bare, naked; γένυς, a cheek). † *Polyboroides*: like a *Polyborus* or Caracara.

that lies in its course, making them unsettled and wild."* The same authority furnishes the following interesting particulars about the habits of the present species:—"In Andalusia, as well as in Morocco, over all low wet ground, the Marsh Harrier is to be seen in vast numbers, particularly in winter. Great quantities remain to breed, sometimes as many as twenty nests being within three hundred yards of one another. The latter, loosely constructed with dead sedges, vary very much in size and depth, and are usually placed amidst rushes in swamps, but sometimes on the ground among brambles and low brushwood, always near water, though occasionally far from marshes. They begin to lay about the end of March, and at that time fly up a great height, playing about, and continually uttering their wailing cry. The eggs are bluish-white, and usually four or five in number; they certainly vary in size and shape, and are often much stained. Like the eggs of all the Harriers that I am acquainted with, and many others of the Accipitres, when blown and held up to the light they show a bluish



MARSH HARRIER.

tinge. I once found a nest containing only one egg nearly ready to hatch, and saw another with six eggs (three quite fresh, and the other three hard sat on). I believe that if the first set of eggs be taken they lay again in a fresh nest, as I found sets of fresh eggs as late as the 2nd of May.

"Cowardly and ignoble, they are the terror of all the poultry which are in their districts, continually carrying off chickens, and, like other Harriers, are most terribly destructive to the eggs and young of all birds. On account of these propensities, I never let off a Marsh Harrier unless it spoiled sport to fire at one. Sometimes, when at Casa Vieja, and the Snipe were scarce, we used to lie up in the line of the Harriers' flight to their roosting-places; for they always take the same course, and come evening after evening within five minutes of the same time. Upon one occasion a friend and myself killed eleven, and during the visit accounted for over twenty. I also upon every possible opportunity destroyed the nest and shot the old ones; but it was the labour of Sisyphus, for others immediately appeared. However, there was a visible diminution of their numbers at Casa Vieja. I never saw rats in their nests or crops, and believe they have not the courage to kill them; small snakes, frogs, wounded birds, eggs, and nestlings unable to fly, form the main part of their prey. I have seen the

* Col. Irby, "Ornithology of the Strait of Gibraltar," p. 34.

Marsh Harrier hawking over the sea about two hundred yards from the shore, where there was shallow water, but could not see what they were taking."

THE HARRIER-HAWKS (*Micrastur* *).

These constitute a little genus of Hawks peculiar to the New World, where they form a perfect link between the Harriers and the Goshawks. In form they are stoutly-built birds like the latter, while they retain the facial ruff of the Harriers, and hence the name of Harrier-Hawk adopted for them here. Their habits are well described by a good observer, the late Colonel Greyson, of the U.S. Army, who writes of the largest species of the genus, the Harrier-Hawk (*Micrastur semitorquatus*) :—

"Among the great variety of Hawks to be met with in a single day's excursion in the locality of Mazatlan, none are so easily recognised as this peculiar and interesting species. I have found it only in the heavy forests, or the immediate vicinity of a thickly-wooded country, where its slender form and lengthened tail attract our attention as it swiftly glides through the tangled woods with that remarkable ease which we have often noticed in the Sharp-shinned Hawk (*A. fuscus*). It appears to be strictly arboreal in its habits, and possessed of wonderful activity, either in springing from branch to branch without opening its wings, or rapidly darting through the intricacies of the bush with apparently but little difficulty. I have seldom seen one of these Hawks in an open country, and have never seen one flying higher than the tree tops, where they are met with. Its wings are rather short, and its flight is performed by rapidly repeated strokes, only for a short distance at a time. It preys upon various species of wood birds, which it captures by darting upon them on the ground or in the bushes; but the Chachalaca is its favourite game. This is a gallinaceous bird, or wild chicken, about the size of, or lighter than, the common hen, and is entirely arboreal, seldom running upon the ground, but is able by its peculiarly-formed feet to cling to, or spring rapidly through, the thickest branches with great agility; but this Hawk follows it with equal facility, until an opportunity offers to strike its prey, then both come to the ground together, the Hawk being the lighter bird. I witnessed a scene of this kind that took place when I was endeavouring to get a shot at a Chachalaca, as it was jumping about the very thick branches of an acacia overgrown with lianas; it appeared to be in great distress, uttering its harsh notes of alarm, and spreading its fan-shaped tail. Suddenly I saw one of these Hawks pounce upon it; when with harsh screams of terror and pain the Chachalaca dragged its captor to the ground, where they struggled for a few moments, but the unfortunate bird was soon overcome. The struggling and screams of the Chachalaca created a great commotion among the denizens of the woods; far and near were heard the harsh cries of other members of its family, and the Urraca Magpie, with streaming tail and ludicrous gesticulations, as well as the Blue-back Jay, and other birds in the neighbourhood, gathered around to witness the scene of rapine. Suddenly appeared in the midst of this clamour a larger Hawk (*Buteo Harrisi*, Aud.), which rushed at once upon the captor of the Chachalaca. Unable to withstand so heavy a charge, he was compelled to give up his honestly captured prey to a superior force, thus proving the old adage that 'might is right.' The slender but compact figure of our present subject was now seen perched upon a neighbouring bough, scrutinising, with a vicious eye, the more powerful but less active bird of prey, as he vainly attempted to bear off the lifeless form of the Chachalaca; but there was one yet mightier than he. I observed it for a few moments, then shot it, as also the Long-tailed Hawk, thus securing all three.

"They build their nest of dry twigs and moss, which is placed in a very tall tree, but below the higher branches. The only nest I have seen was inaccessible, therefore I regret that I am unable to describe the eggs."

THE CHANTING GOSHAWKS (*Melierax* †).

These birds are met with in Africa only, and they have received the name of "Chanting" Goshawks from their song, which has been stated by the French traveller, Levaillant, to be of considerable power, for he says he has heard the male of the Cape species (*Melierax canorus*) sing for hours together in the twilight of morning and evening, and sometimes through the night. This, however, has been

* μικρός, small; *astur*, a Goshawk. See "Lawrence's Birds of Western and North-Western Mexico." "Memoirs of the Boston Soc. of Nat. Hist.," Vol. ii., p. 299.

† μέλι, honey; ἱέραξ, a Hawk.

questioned by Mr. Layard, who is well known as an authority on African birds, and who observed the species in some abundance in certain parts of South Africa. According to this observer, the bird will perch on the top of a high tree, utter its "mellow piping whistle," and fly off again. He has also heard it call when flying. Now, although the Chanting Goshawks may not have such powers of song as have been credited to them, it is certain that they really have a more varied note than is the case with other Goshawks, and the Red-faced Goshawk (*Melierax gobar*) is said to whistle very much and better than *M. canorus*. About five different species of Chanting Goshawks are known, all being from Africa: hence the genus *Melierax* is one of those forms characteristic of the *Ethiopian region*, which embraces Africa below the Sahara desert. One species only, the Many-banded Goshawk (*Melierax polyzonus*), a frequent bird in Abyssinia and Senegambia, is known to wander beyond the limits of the above-named region, as it occurs in Mogador, whence living specimens have been more than once sent to the Zoological Gardens.

The habits of the Chanting Goshawks are very similar to those of the ordinary Goshawks of more northern climates, the larger species feeding on Quails, Francolins, and other small game, reptiles, and locusts, while the less powerful kinds devour small birds and reptiles. The colour of the plumage is a pearly-grey in the South African Chanting Goshawk (*M. canorus*), the belly being white with greyish cross-lines; the rump is white; the primary quills black; tail dusky, tipped with white and crossed by broad white bars; the cere and legs are red; the iris dark brown. It measures about three feet in length. This style of colouring is found in all the species, excepting one small one, which is entirely black all over, save some white spots on the tail, and is known as the Black Goshawk (*Melierax niger*).

THE TRUE GOSHAWKS (*Astur*).

These are represented nearly all over the world, every country having one or more species of the genus Astur, excepting the continent of South America, which possesses only two kinds, both of them rare and of limited range. More than thirty different species of the genus have been described, and they present great differences in size and style of coloration, their habits varying equally, according to the strength and power of the birds; but they are all remarkable for a very sturdy bill, and thick-set legs and sharp talons. A Goshawk may always be told by the latter characters, and by its short toes, which are perhaps smaller in proportion to the size of the bird than in any other group of the birds of prey.

These birds, and the Sparrow-Hawks, have very short wings, and have not the same power of flight as in the true Falcons, which are long-winged birds; and hence, in the old days of falconry, they were never considered of such value as the Peregrine in the chase. They were also called Hawks of the "fist," as they were flown at game from the hand, instead of soaring down on the quarry from aloft.

THE GOSHAWK (*Astur palumbarius*).

This is the largest and most powerful of all the genus, as it is also the best known, being found all over the northern parts of Europe and Asia. It used to be of more frequent occurrence in Britain formerly than it is now; and although it can only nest in this country on the rarest occasions in the present day, the author was introduced to an old gamekeeper on the Marquis of Huntly's estate at Aboyne, who perfectly remembered the Goshawk breeding regularly at Glentanner. A young bird is still captured now and then in autumn, one of the last instances being that of a young male, who was captured in an area at Hampstead, on the 3rd of August, 1872, and is now in the British Museum.

It will feed on nearly every kind of bird and animal that it is able to catch, and in falconry it is principally employed to take Hares and Rabbits; it will also take Pheasants and Partridges, a great number of these latter birds being killed by the Goshawk in its wild state. It is able to pursue its quarry with great dexterity through a wooded country, and it possesses great powers of abstinence, so that, if its prey escapes into cover for the time, the Hawk will often wait for its re-appearance, and will generally exhaust the patience of the quarry, and succeed in capturing it. During the day-time it remains solitary in dark fir-forests, and comes out to feed in the morning and evening. The nest is often a huge structure, being added to year by year; and an immense nest is figured in

Professor Newton's "Ootheca Wolleyana." Some idea of the size may be gained from the story told by Mr. Wolley, who climbed up to one that was placed a good height up in a large Scottish fir, and when he stood on the same branch with the nest, the latter still reached several inches above his head, so that the building of this nest had probably been the work of several years.

GOSHAWK.

The old birds are alike in plumage; but the female, as is the case with all Goshawks, is larger than the male, measuring about two feet in length, while the male does not exceed twenty inches; the wing also, which is about twelve inches in the male, exceeds fourteen in the female. The colour is grey, the head black, the sides of the face white, streaked with black lines; below, the under surface of the body is white, barred across with black cross-bars of ashy-brown; the under tail-coverts are white; quills and tail ashy-brown, the tail feathers tipped with white; cere yellow; bill bluish; iris orange. The young birds differ considerably from the adults, being rufous below, with longitudinal streaks of dark brown; the upper surface is brown, all the feathers being margined with reddish-white.

In North America, a bird very similar to the Goshawk takes its place; and a third species of the same group is found in Madagascar only. It is, however, principally in the Malayan Archipelago that the greatest number of species occur, nearly every island possessing a Goshawk peculiar to itself.

THE SPARROW-HAWKS (*Accipiter*).

These may almost be called miniature Goshawks, as they are not only short-winged birds like the latter, but they even have the same style of plumage, consisting generally of a dark-grey back, a barred under surface, and a piercing yellow eye. They may, however, be distinguished from the Goshawks by their small, weak bill, and long, slender, middle toe. With the exception of some of the Oceanic Islands, Sparrow-Hawks are found all over the world, being plentiful even in South America, where the rarity of the Goshawks has already been alluded to.

THE COMMON SPARROW-HAWK (*Accipiter nisus*).

This is an active and plucky little bird, which still holds its own in England, notwithstanding the raids made upon its nest, and the destruction of old birds by keepers. Nor can it be denied that the Sparrow-Hawk, hatching its young about the time when the young chickens and Pheasants are also being reared, will occasionally make a swoop on the pheasantry, and carry off the chicks to feed its own offspring. The principal food of this Hawk is small birds, in the pursuit of which it is so eager

that it has several times been known to dash through a glass window, and be caught in the room; while Messrs. Salvin and Brodrick, in their work on British Falconry, state that they have "known a trained Sparrow-Hawk force itself to such an extent into a blackthorn bush, where it had killed a bird, as to require to be cut out." Like the Goshawk, it is often trained for hawking, but is a much more delicate bird to rear, and requires careful management when young. Nevertheless, a well-trained Sparrow-Hawk will account for a considerable number of birds; and in the work of the above-mentioned authors is given an instance of one Hawk having killed 327 head in less than two months, consisting of Sparrows, Blackbirds, Thrushes, a few Partridges, and Linnets, more than two-thirds of the number being Sparrows.

In size the female Sparrow-Hawk is considerably larger than the male, measuring nearly sixteen inches in length, and nine inches and a half in the wing. She is generally paler grey, never so blue as in the male, nor is she so red underneath. A sign of age, by which a mature hen Sparrow-Hawk may be known, is the presence of a tuft of rufous plumes on the flanks, which is feebly developed in the young bird, but is a conspicuous feature in the adult.

The male is bluish slate-colour above, the quills browner and barred across with darker brown, these bars being very distinct below; the tail is barred with blackish-brown, and tipped with white; cheeks and ear-coverts are rufous; under surface of body whitish, with narrow bars of bright rufous, the under tail-coverts white, as are also the under wing-coverts and axillaries, these two latter parts being spotted with brown. Young birds are brown with rufous edges to the feathers; underneath they are rufous, barred with brown on the flanks and breast, the throat and fore-neck streaked with the same colour. The bars on the tail are five in number in a young male, but as the bird increases in age the number of bars decreases, and is generally only four in a very old bird: the same takes place in the female. The range of the Common Sparrow-Hawk is very similar to that of the Goshawk, being extended all over Europe and Northern Asia, and into Northern China and North-western India. Neither of the birds go to South Africa, and range into the north-eastern portion of that continent only in winter.

SPARROW-HAWK. (*After Keulemans*)

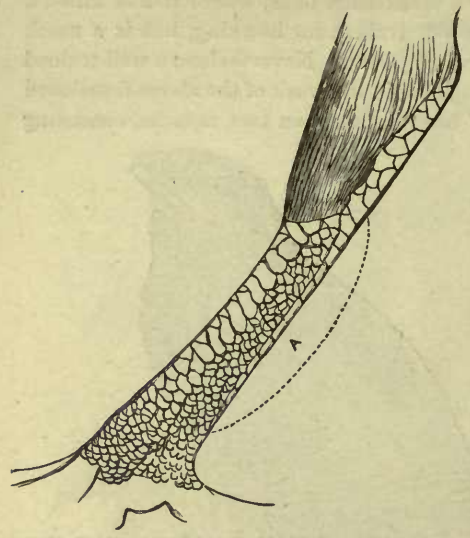
THE THIRD SUB-FAMILY.—THE BUZZARDS (*Buteoninæ*).

These Hawks constitute a numerous assemblage of the birds of prey, and lead on from the long-legged Hawks of the previous sub-family to the Eagles, ending with the Great Harpy, which is, perhaps, the most powerful bird of prey in the world. All the Buzzards have the tibia much longer than the tarsus, but they may be distinguished from all the Eagles, Kites, and Falcons by having the back of the tarsus "plated," and not "reticulated." In the accompanying woodcuts is shown the hinder aspect of a Buzzard's tarsus (figure on p. 274), by which it will be seen that the scales are arranged in plates, very differently from that which takes place in the tarsus of an Eagle (figure on p. 274), where the scales are reticulated.*

The Buzzards are more numerous in the northern parts of the world than in the tropics, and a large decrease in the number of species takes place in Central and Southern America, whilst in Oceania and Australia they are altogether absent. As a rule, they are birds of plain plumage and

* *Rete*, Lat., a net, so called on account of the network pattern.

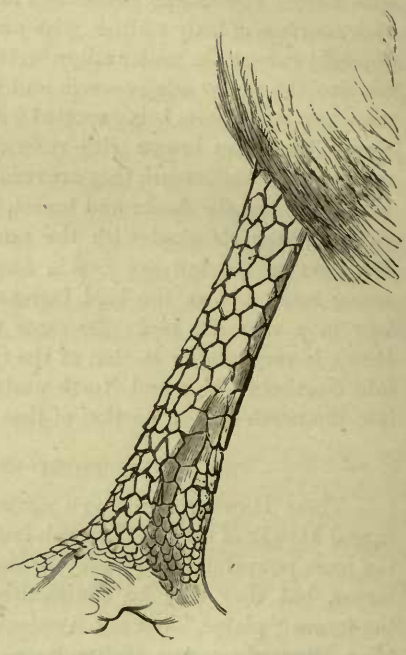
sluggish habits, possessing neither the courage of the Eagles, nor the dash and adroitness of the Falcons, in capturing their prey. Africa produces some species which, as regards plumage, are an exception to the general rule, the Augur and Jackal Buzzards (*Buteo augur* and *Buteo jackal*) being rather handsome birds, their plumage being a mixture of black and chestnut.



HIND VIEW OF TARSUS OF BUZZARD, SHOWING THE PLATED ARRANGEMENT OF SCALES (A).

THE COMMON BUZZARD (*Buteo* vulgaris*).

This is a strictly European bird, although it has been stated to occur in Central Asia, and to sometimes wander into North-eastern Africa. Like all other birds of prey, it is rather rare in Great Britain, but it still breeds in certain localities, although the great majority of specimens which are killed in Britain are found in the fall of the year. The power of the Common Buzzards to attack large game is very limited, and Mr. Robert Gray† observes :—"To many persons it will seem unwise, I dare say, to call this Buzzard a useful bird in game preserves, yet I cannot but think that if the experiment were made of allowing it to fulfil the ends for which Nature designed it, our native game birds would benefit by the trial. So far as my own observations have extended, the Common Buzzard is just the kind of instrument wanted to clear off sickly young birds, which, on arriving at maturity, yield an offspring of a degenerate breed. Of somewhat sluggish habits, it does not care to interfere with strong-winged birds, being content with those that, through wounds or a naturally feeble constitution, are unable to save themselves. In this way only strong birds are left, and a healthy breed ensues. Let any of our proprietors of moors, who are jealous of the daring prowess of Eagles and lordly Peregrines, act upon this hint, and I will venture to say we should have fewer instances of disease amongst game birds to chronicle."



HIND VIEW OF TARSUS OF SERPENT EAGLE, SHOWING THE RETICULATED ARRANGEMENT OF SCALES.

Although the Buzzard does not quarter the ground like a Harrier, and search for its prey on the wing, it may not unfrequently be seen circling in the air at a considerable height, generally over the place which contains its nest, but as a rule it perches on some stone or similar resting-place, whence it watches for its prey. When flying it utters a clear loud cry, which has been described as "mewing." Its principal food consists of Field Mice, but it also devours Moles, young birds, the caterpillars of Hawk Moths (*Sphingidæ*), Grasshoppers, and it will also occasionally feed on carrion, or on dead fish cast up on the sea-shore. When migrating in the autumn, which it does in considerable numbers together, a good many are caught for the purposes of food, and the manner of catching them is thus described by Nilsson in his work on the birds of Sweden :—"In October, when they pass through Skåne on their passage to the south, they remain for some time on the outermost point of land to await a suitable westerly wind to cross. Large numbers collect and roost at night in the trees (especially in the willows) which grow there. When the darkness sets in, two men go in company to catch them, one with a sack, and the other with a stout cudgel. The latter climbs quietly up into the tree, where he can just distinguish the bird, whilst the other remains below; and so soon

* *Buteo*, Lat., a Buzzard.

† "Birds of the West of Scotland," p. 46.

as the climber has got up to where he can reach a bird, he catches it by the legs with the left hand, and either twists its neck with his right hand, or stuns it with a blow of the cudgel, and throws it down to his companion on the ground, who crams it into the sack. In this manner two men can catch thirty or forty in the evening, or, according to Burgomaster C., as many even as seventy or eighty ; and Captain E. relates that twenty were obtained one evening from the same tree. They are easiest to catch when it is dark and blowing hard, so that the bird cannot easily hear the noise. In all, many hundreds are caught annually, some of which are cooked fresh or made into soup, but most are salted down and kept for use during the winter."

The nest of the Buzzard is generally placed on some non-evergreen tree at various heights from the ground, but in Scotland it builds on rocks. The usual number of eggs is three or four, and these

COMMON BUZZARD.

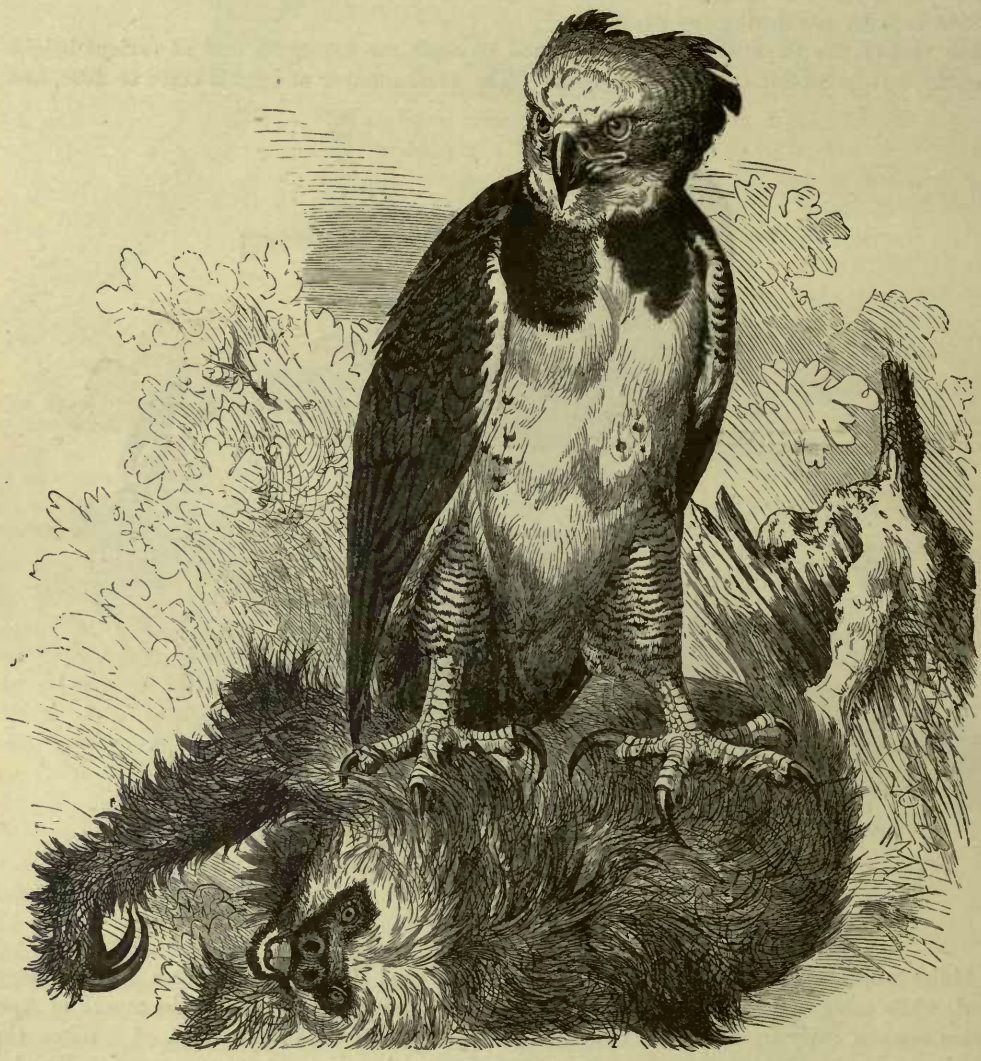
are a bluish-white, with reddish blotches. They vary a good deal in colour, some being rather richly marked, while others are almost colourless. The time of breeding is generally the month of April, or, in severe seasons, early in May. A Crow's nest is occasionally taken possession of. When the bird makes its own nest, this is formed of large branches with a lining of grass, occasionally of a few feathers. No bird varies more than the Buzzard in plumage, and many beautiful variations in its dress take place before the adult plumage is gained. The old bird is almost entirely brown above and below, the breast and abdomen generally having a more or less barred appearance ; the quills are brown, banded with darker brown, and shaded with grey on their outer aspect ; the tail is ashy-brown, more or less inclining to rufous, and having twelve or thirteen bars of darker brown. Young birds have a great deal of white about their plumage, some of them being nearly cream-coloured. The size of the adults is about twenty-two inches, and the sexes vary a little in dimensions, the wing of the female being perhaps one inch longer than that of the male.

The great utility of the Buzzard in destroying Mice ought to render it an object of protection and encouragement, for the number of small Mammals destroyed by these birds is immense. Brehm

calculates that when they have young they will destroy at least one hundred Mice a day, and mentions that thirty Field Mice have been taken from the crop of a single bird.

THE HARPY (*Thrasatus* harpyia* †).

Although from its size and courage this bird is generally called the *Harpy Eagle*, it is evident from its structure that it is a Buzzard, as it possesses the "plated" tarsi of the latter group of birds



THE HARPY.

It is an inhabitant of the New World, from Mexico through Central America to Brazil and Bolivia. It is a very destructive bird, causing great damage to the flocks, and even destroying calves, whence it is an object of detestation to the stock-keepers in Mexico. It also feeds on deer and on the large Macaws which are found in the forest it frequents. It stands more than three feet and a half high, and has a large crest, which, together with its powerful talons and glittering eye, gives the bird an imposing aspect even in captivity. In the adult bird the coloration is ashy-grey, inclining in very old examples to silvery grey relieved by the dark ash-coloured wings and tail.

* θράσος, daring; ἀετός, an Eagle. † ἅρπη a bird of prey.

CHAPTER V.

EAGLES AND FALCONS.

THE EAGLES—THE BEARDED EAGLE, OR LÄMMERGEIER—A Visit to their Nest—Habits—A Little Girl carried off alive——Habits in Greece—Appearance—Von Tschudi's and Captain Hutton's Descriptions of its Attacks—THE TRUE EAGLES—THE WEDGE-TAILED EAGLE—Eye—Crystalline Lens—How Eagles may be Divided—THE IMPERIAL EAGLE—THE GOLDEN EAGLE—In Great Britain—Macgillivray's Description of its Habits—Appearance—THE KITE EAGLE—Its Peculiar Feet—Its Bird's-nesting Habits—THE COMMON HARRIER EAGLE—THE INDIAN SERPENT EAGLE—THE BATELEUR EAGLE—THE WHITE-TAILED EAGLE—A Sea Eagle—Story of Capture of some Young—THE SWALLOW-TAILED KITE—On the Wing—THE COMMON KITE—THE EUROPEAN HONEY KITE—Habits—ANDERSSON'S PERN—THE FALCONS—The Bill—THE CUCKOO FALCONS—THE FALCONETS—THE PEREGRINE FALCON—Its Wonderful Distribution—Falconry—Names for Male, Female, and Young—Hawks and Herons—THE GREENLAND JER-FALCON THE KESTRELS—THE COMMON KESTREL—Its Habits and Disposition.

THE THIRD SUB-FAMILY OF THE FALCONIDÆ.—THE EAGLES (*Aquilinæ*).

As already explained, the Eagles may be distinguished from the Buzzards by their reticulated tarsus; otherwise the proportions of the leg-bones are similar, the tibia being considerably longer than the tarsus.

THE BEARDED EAGLE, OR LÄMMERGEIER (*Gypaëtus barbatus*).

The generic name of this Eagle is derived from two Greek words (γύψ, a Vulture, ἀετός, an Eagle), and no name could have been better chosen, for with the structure of an Eagle it combines many of the habits of a Vulture, and has many ways in common with the Egyptian Vulture (*Neophron percnopterus*). In Europe it is found only in the mountainous parts of those countries bordering the Mediterranean basin, and is now nearly extinct in Switzerland. In the mountains of Spain, however, it is still to be met with in some quantities, and Mr. Howard Saunders states that one or two pairs may be found in every range of mountains. In Sardinia it is said by Mr. Basil Brooke to be decidedly common, and during one of his visits to that island he obtained a very curious nestling bird covered with down. "A pair of these birds," says Mr. Brooke, "are in possession of every separate range of hills, which they appear to regard as their own territory, and from which they are seldom to be found far distant. They are generally to be seen singly or in pairs; but now and then I have observed three, and on one occasion four together. As a rule they are most decidedly mountain birds, but occasionally a single bird may be seen hunting over the plains and cultivated lands, not flying more than one hundred yards high. The nest of one found on the 18th of April was built on a broad ledge of a precipitous cliff, about three hundred feet high, within twenty feet of the top, and was completely sheltered from the severity of the weather by a large overhanging piece of rock. After some trouble I discovered a way by which, with a little care, I managed to get on the ledge, much to the discomfort of the solitary inmate—a young nestling, covered as yet with a pale yellowish-brown down. The nest itself was an accumulation of dried sticks, with a cup-shaped hollow in the middle, and had evidently been used for years. In it, and on the surrounding ledge, were great quantities of the leg-bones and feet of goats, &c., and a part of a fox's lower jaw; these being in all stages of putrefaction, the smell was abominable. The old female on my first visit to the nest sat extremely close, and although I was standing over her within seven or eight yards, would not leave her young until I fired a shot, upon which she dashed off, dropping almost perpendicularly, and was out of range before I could fire. She flew over the valley and lit upon a high-projecting, rocky pinnacle, upon which I could see her through the telescope, sitting quietly watching all my proceedings. She returned to the nest shortly afterwards, on my having retired to a little distance."

In Algeria the Lämmergeier is said to feed largely on Land Tortoises, which it carries to a great height in the air, and drops upon a convenient rock, so as to break the shell. So much has been written upon the habits of this bird that it would be impossible to give here one tithe of the interesting notes which have been published in various works and periodicals; but no history of the species, however brief, would be complete without a passing mention of the little girl who was said to have been carried off in childhood by one of these birds. The history,

believed by him to be well authenticated, is related by Naumann as follows.—"Anna Zurbuchen, of Hatchern, in Bern Oberland, born in 1760, was taken out by her parents, when she was nearly three years old, when they went to collect herbs. She fell asleep, and the father put his straw hat over her face and went to his work. Shortly after, when he returned with a bundle of hay, the child was gone; and the parents and peasants sought her in vain. During this time Heinrich Michel, of Unterseen, was going on a wild path to Wäppesbach, and suddenly heard a child cry. He ran towards the sound, and a Bearded Vulture rose, scared by him, from a mound, and soared away over the precipice. On the extreme edge of the latter, below which a stream roared, and over whose edge any moment would have precipitated it, Michel found the child, which was uninjured, except on the left arm and hand, where the bird had probably clutched it; its shoes, stockings, and cap were gone. This occurred on the 12th of July, 1763. The place where the child was found was about 1,400 paces distant from the tarn where it had been left asleep. The child was afterwards called *Lämmergeier-Anni*, and married Peter Frutiger, a tailor in Gewaldswyl, where she was still living in 1814."

The circumstantial way in which the above narrative runs appears to leave little doubt of its reality, but it is difficult to give it credence, as the Lämmergeier has but little power in its feet, which resemble those of the Vultures; and most of the stories of its prowess have been discredited by the researches of modern naturalists. Dr. Brehm observes:—"To my intense astonishment, the Spanish hunters did not regard this bird in the slightest degree as a bold, merciless robber: all asserted that it fed on carrion, especially bones, only attacking living animals when driven by necessity. They called it 'Quebranta-Huesos,' or the 'Bone-smasher,' and assured me that this favourite food was broken in a singular manner. My later observations proved nothing which would justify my treating their statements as otherwise than correct, so I was forced to come to the conclusion that the Lämmergeier had been much maligned. Since my first account of this bird, I have read a number of communications from other observers, and gather from the whole that the Bearded Vulture is nought else than a weak, cowardly bird of prey, gifted neither in mind nor body to any great extent, and one that but rarely carries away small mammals. Its food usually consists of bones and other carrion."

Mr. Hudleston met with the Lämmergeier in Greece, where, however, it was not common, and he writes of its habits as observed by him:—"He is not a demonstrative bird like the Griffon, who may be seen sailing about at a great height in the air, sometimes alone, but more often in troops of from half a dozen to fifty, revolving in endless circles round each other, that no corner may remain unseen. The Lämmergeier, on the contrary, may be observed floating slowly, at a uniform level, close to the cliffs of some deep ravine, where his shadow is perhaps projected on the wall-like rocks. If the ravine has salient and re-entering angles, he does not cut across from point to point, but preserves the same distance from the cliff; and when he disappears in any natural fissure, you feel sure of the very spot where he will emerge on turning the corner of the precipice. Marrow-bones are the dainties he loves the best; and when the other Vultures have picked the flesh off any animal, he comes in at the end of the feast and swallows the bones, or breaks them and swallows the pieces, if he cannot get the marrow out otherwise. The bones he cracks by taking them to a great height and letting them fall on a stone. This is probably the bird that dropped a Tortoise on the bald head of poor old Æschylus. Not, however, that he restricts himself, or the huge black infant that he and his mate are bringing up, in one of the many holes with which the limestone precipice abounds, to marrow, turtle, bones, and similar delicacies: neither lamb, hare, nor kid comes amiss to him—though, his power of claw and beak being feeble for so large a bird, he cannot tear his meat like other Vultures and Eagles. I once saw a mature bird of this species which had evidently swallowed a bone, or something uncommonly indigestible, close to the *abattoir* at Athens. He was in a very uncomfortable attitude, and appeared to be leaning on his long tail for support. After riding round in gradually decreasing circles till within ten yards, I dropped off horseback and made a rush at him, but he just managed to escape, and then rising slowly till about the height of the Acropolis, made off towards the gorge of Phylæ, where there is an eyry.

"The Lämmergeier has an extremely ugly countenance; this becomes perfectly diabolical when he is irritated, and shows the bright red round his eyes. Altogether, what with his black beard, rufous

breast, and long, dark tail, he is an awful-looking beast, and has the reputation of committing divers evil deeds—such, for instance, as pushing lambs and kids, and even men, off the rocks, when they are in ticklish situations. Nevertheless, he is a somewhat cowardly bird, has a feeble, querulous cry, and will submit to insults from a Falcon not a fourth his size or weight."

Von Tschudi says that in Switzerland it will capture Hares, Martens, Squirrels, Crows, and Woodcocks, and he states that a stomach was found to contain five pieces of Bullock's ribs two inches thick and from six to nine inches long, a lump of hair, and the leg of a young Goat from the knee to

BEARDED EAGLE, OR LÄMMERGEIER.

the foot. The bones were perforated by the gastric juice, and partly reduced to powder. The stomach of another Lämmergeier, examined by Mr. Schinz, contained the large hip-bone of a Cow, the skin and fore-quarters of a Chamois, many smaller bones, some hair, and a Heath-cock's claws. Should a Lämmergeier see an old Chamois or a Sheep or Goat grazing near a precipice, it will whirl round and round, trying to torment and frighten the creature till it runs to the edge of the cliff, and then, falling down upon it, the bird not unfrequently succeeds in pushing it into the abyss below with one stroke of its wings. Diving down after its mangled victim, it will begin by picking out its eyes, and then proceed to tear open and devour the body. It is only the smaller class of booty, such as Foxes, Lambs, or Marmots, which can be carried off by the Lämmergeier, as its feet and claws, as we have already remarked, are comparatively weak.*

In the Himalayas, where the species is also tolerably plentiful, its habits vary somewhat, and it

* "Sketches of Nature in the Alps."

not unfrequently comes close to habitations for offal or bones, and behaves in a very Vulturine manner. Captain Hutton writes:—"Marvellous, indeed, are the stories told, both by natives and Europeans, of the destructive habits of this bird, and both accounts, I fully believe, have scarcely a grain of truth in them: all I can positively say on the point, however, is that I have known the bird well in its native haunts for thirty years and more, and never once, in all that time, have I seen it stoop to anything but a dead carcase. As to carrying off hens, dogs, lambs, or children, I say the feat would be utterly impossible, for the creature does not possess the strongly-curved, sharp-pointed claws of the Eagle, but the far straighter and perfectly blunt talons of the Vulture. Day after day I have seen them sweeping by along the face of the hill, like the wandering Albatross at sea, and, like it, ever in search of offal, which, when found, is not swept off the ground after the manner of the Kite, but the bird alights upon it, as it would upon a Bullock, and then, if the morsel is worth having, devours it on the spot, and again launches itself upon its wide-spread wings and sails away as before. There is no sudden stooping upon a living prey, as with the Falcon tribe, but its habits and manners in this respect are, as far as I have seen, entirely Vulturine."

The Lämmergeier measures about three feet and a half in length, and its outspread wings often extend to as much as nine feet in expanse. A second species is found in Africa, the Southern Lämmergeier (*Gypaëtus ossifragus*), which differs from the European one, in having the tarsus bare, instead of being feathered to the toes.

THE TRUE EAGLES (*Aquila*).

In Australia no true Eagle is found, but a very powerful bird called the WEDGE-TAILED EAGLE (*Uroaëtus* audax* †) inhabits that country, differing from all its more northern relations in its very long and wedge-shaped tail, which is like that of the Lämmergeier.

EYE OF EAGLE, SHOWING CRYSTALLINE LENS. (*After Yarrell.*)

The true Eagles have a very powerful bill, with a festoon distinctly marked in the edge of the upper mandible, which is, however, different from the toothed bill of the Falcons, to be considered presently. They nearly all possess a large bony shelf over the eye, which may serve to protect that organ from the sunlight during some of the aërial excursions the bird makes.

The orb of the eye in the Eagles is supported by a ring of bony plates, numbering fifteen in the Golden Eagle. These bony plates are capable of slight motion upon each other. The figure represents the crystalline lens of the same bird, the lens being subject to great variety of form in different birds. In the Eagle the proportion of the axis to the diameter of the lens is as $3\frac{8}{10}$ to $5\frac{7}{10}$; in the Eagle Owl, which seeks its prey at twilight, the relative proportions of the lens are as $6\frac{7}{10}$ to $7\frac{8}{10}$; and in the Swan, which has to select its food under water, the proportions of the lens are as 3 to $3\frac{8}{10}$. Birds have also the power of altering the degree of the convexity of the cornea. With numerous modifications of form, aided by delicate muscular arrangement, birds appear to have the power of obtaining such variable degrees of extent or intensity of vision as are most in accordance with their peculiar habits and necessities.‡

In these birds is found a return of that difference in the size of the sexes which was so noticeable in the Sparrow-Hawks, for in the Eagles the female is decidedly larger than the male. There are two convenient groups into which the Eagles may be divided, according as they have feathered or unfeathered legs. All the true Eagles belong to the first section, all the less noble and Serpent-eating kinds to the latter section. Although they are birds of grand physique, it is a question whether Eagles deserve the position they enjoy for nobility of disposition: they are rapacious it is true, but not always brave, for one Golden Eagle will give way to a Peregrine Falcon, while the grand-looking IMPERIAL EAGLE (*Aquila heliaca*, see figure on p. 235) is said by a good observer in India, Mr. A. O. Hume, C.B., to be no better than a great hulking Kite. He adds:—"Much has been written about the daring and fierceness of this Eagle. I can only say that in India (where possibly the climate is subversive of

* οὐρά, a tail; ἀετός, an Eagle. † *Audax, bold.* ‡ Newton Ed., Yarrell's "British Birds," i., p. 19.

courage), I have never seen the slightest indications of these qualities. I have driven the female off hard-set eggs, and plundered the nest before the eyes of the pair, without either of them flapping a pinion even to defend what a little Shrike will swoop at once to save; and I have seen a couple of Crows thrash one of them soundly. As a rule, this species with us is an ignoble feeder. I have generally found them gorged with carrion, and after a good meal they will sit stupidly on a tree, or any little mud pillar, and permit you to walk within thirty yards of them; but before feeding they are somewhat wary, and can by no means always be secured, even when seen sitting. On more than one occasion I have seen Desert Rats (*Gerbillus erythrurus*) in their crops, and I once shot one of a pair which were busy, on the line of rail at Etawah, devouring a Bandicoot Rat (*Mus bandicota*), which some passing train had cut in two. Occasionally, but rarely, I found that they had eaten Quails and other birds. Once I shot a male which was dancing about on the ground in such an astounding fashion that I killed it to see what the matter was. The bird proved to have been choking. It had swallowed a whole dry shin-bone and foot of an Antelope. The bone apparently could not be got down altogether, and in trying to void it, the sharp points of the hoof had stuck into the back of the roof of the mouth."*

THE GOLDEN EAGLE (*Aquila chrysaëtus* †).

The Golden Eagle is so called from the tawny or golden-brown colour which pervades the feathers of the neck in the old bird. Excepting in certain places in "Caledonia stern and wild," where it is protected, it is a species which is becoming very rare in Great Britain, and but for the intervention of a few large-minded proprietors in Scotland would doubtless ere this have been extinguished. It is a much rarer bird now than the White-tailed Eagle, and the last-named species is often mistaken for it; but a little attention to one point will obviate all fear of a mistake in this respect, the Golden Eagle having at all ages the tarsus feathered to the toes, whereas the Sea Eagle belongs to the bare-legged section of these birds.

A better description of the habits of the Golden Eagle probably does not exist than that given by the late Professor Macgillivray:—

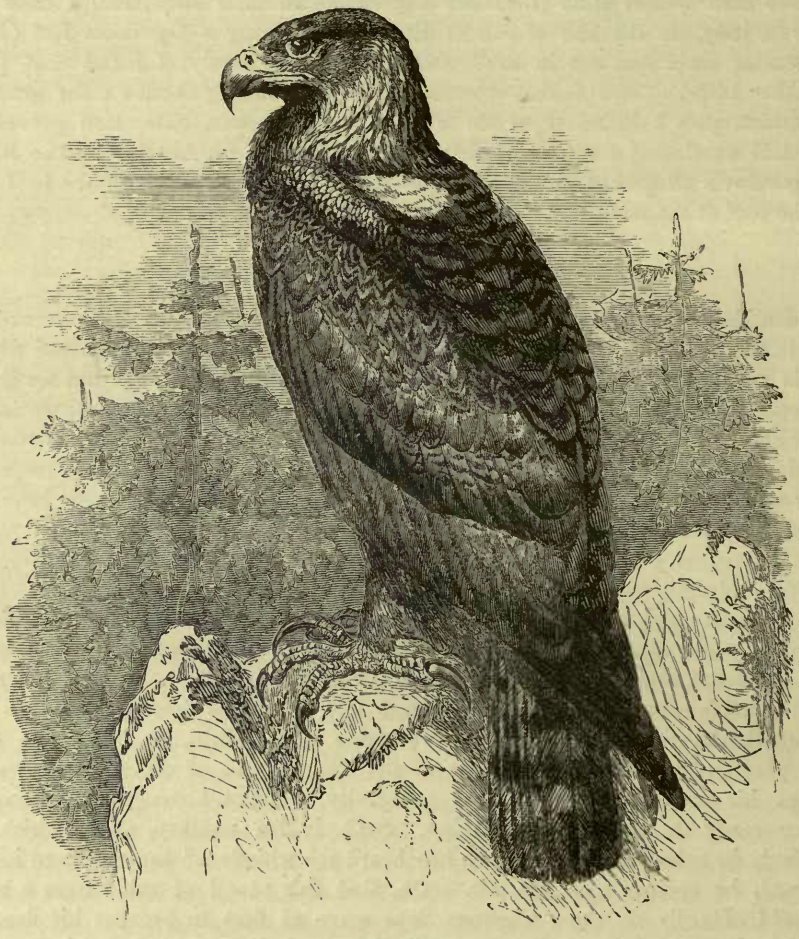
"See how the sunshine brightens the yellow tint of his head and neck, until it shines almost like gold! There he stands, nearly erect, with his tail depressed, his large wings half raised by his side, his neck stretched out and his eye glistening as he glances around. Like other robbers of the desert, he has a noble aspect, an imperative mien, a look of proud defiance; but his nobility has a dash of clownishness, and his falconship a vulturine tinge. Still, he is a noble bird, powerful, independent, proud, and ferocious, regardless of the weal or woe of others, and intent solely on the gratification of his own appetites; without generosity, without honour, bold against the defenceless, but ever ready to sneak from danger. Such is his nobility, about which men have so raved. Suddenly he raises his wings, for he has heard the whistle of the shepherd in the corry, and bending forward, he springs into the air. Oh, that this pencil of mine were a musket charged with buck-shot! Hardly do those vigorous flaps serve at first to prevent his descent; but now, curving upwards, he glides majestically along. As he passes the corner of that buttressed and battlemented crag, forth rush two ravens from their nest, croaking fiercely. While one flies above him, the other steals beneath, and they essay to strike him, but dare not, for they have an instinctive knowledge of the power of his grasp, and after following him a little way they return to their home, vainly exulting in the thought of having driven him from their neighbourhood. Bent on a far journey, he advances in a direct course, flapping his great wings at regular intervals, then shooting along without seeming to move them. In ten minutes he has progressed three miles, although he is in no haste, and now disappears behind the shoulder of the hill. But we may follow him in imagination, for his habits being well known to us, we may be allowed the ornithological licence of tracing them in continuance. Homeward bound, his own wants satisfied, he knows that his young must be supplied with food.

"Over the moors he sweeps, at the height of two or three hundred feet, bending his course to either side, his wings wide spread, his neck retracted, now beating the air, and again sailing

* "Rough Notes on Indian Ornithology," p. 145.

† χρυσός, gold; ἀετός, an Eagle.

smoothly along. Suddenly he stops, poises himself for a moment, stoops, but recovers himself without touching the ground. The object of his regards, a Golden Plover, which he had spied on her nest, has eluded him; and he cares not to pursue it. Now he ascends a little, wheels in short curves, presently rushes down headlong, assumes the horizontal position when close to the ground, prevents his being dashed against it by expanding his wings and tail, thrusts forth his talons, and grasping a poor terrified Ptarmigan that sat cowering among the grey lichens, squeezes it to death, raises his head exultingly, emits a clear, shrill cry, and springing from the ground pursues his journey.



GOLDEN EAGLE.

"In passing a tall cliff that overhangs a small lake, he is assailed by a fierce Peregrine Falcon, which darts and plunges at him as if determined to deprive him of his booty, or drive him headlong to the ground. This proves a more dangerous foe than the Raven, and the Eagle screams, yelps, and throws himself into postures of defence; but at length the Hawk, seeing the tyrant is not bent on plundering his nest, leaves him to pursue his course unmolested. Over woods, and green fields, and scattered hamlets speeds the Eagle, and now he enters the long valley of the Dee, near the upper end of which is dimly seen through the grey mist the rock of his nest. About a mile from it he meets his mate, who has been abroad on a similar errand, and is returning with a white Hare in her talons. They congratulate each other with loud yelping cries, which rouse the drowsy shepherd on the strath below, who, mindful of the lambs carried off in spring-time, sends after them his malediction. Now they reach their nest and are greeted by their young with loud clamour.

"Let us mark the spot. It is a shelf of a rock, concealed by a projecting angle, so that it cannot

be injured from above, and is too distant from the base to be reached by a shot. In the crevices are luxuriant tufts of *Rhodiola rosea*, and scattered around are many alpine plants, which it would delight the botanist to enumerate. The mineralogist would not be less pleased could he with chisel and hammer reach that knob which glitters with crystals of quartz and felspar. The nest is a bulky fabric, five feet at least in diameter, rudely constructed of dead sticks, twigs, and heath; flat, unless in the centre, where it is a little hollowed and covered with wool and feathers. Slovenly creatures you would think these two young birds, clothed with white down, amid which the larger feathers are seen projecting, for their fluid dung is scattered all over the sticks, and you see that, had the nest been formed more compactly of softer materials, it would have been less comfortable. Strewn around, too, are fragments of Lambs, Hares, Grouse and other birds in various stages of decay. Alighting on the edges of the nest, the Eagles deposit their prey, partially pluck off the hair and feathers, and rudely tearing up the flesh, lay it before their ever-hungry young."

The length of a male Golden Eagle is a little more than two feet and a half, while the female attains at least three feet in dimensions, with a wing three inches longer than that of her mate. The colour of the plumage is dark brown, with a rich tawny hue on the back of the neck and nape, the feathers of these parts being streaked with darker brown; the tail is more or less mottled with grey at the base, and is whiter in younger birds. The latter are often popularly distinguished as the Ring-tailed Eagles. By some authors the Eagle which frequents the mountains is considered to be a different species from that which inhabits the plains, but as far as present experience goes it is the younger birds which are more often met with in the latter localities, being probably driven from their mountain homes by the older birds. The Golden Eagle varies his choice of an eyry in different localities, building in the British Islands generally on a rock, but in many other countries nesting on a tree. It is found all over Europe and Northern Asia, in mountainous districts, extending into China and even into the Himalayas, whence the finest specimens are obtained. In North America also the examples of the Golden Eagle seem to be very large, but are not to be otherwise distinguished from European specimens.

THE KITE EAGLE (*Neopus* malayensis*).

This extraordinary bird bears the above name from its resemblance generally to a Kite, and also from its plumage, which in the young bird is wonderfully Kite-like, so that a dead specimen carelessly examined might be taken easily for one of the latter birds. One moment's search, however, would dispose of the illusion, for no one who has once heard of the foot of this Eagle could ever forget it or mistake it for that of any other raptorial bird, the talons being longer and more slender in proportion to the size of the foot than in any known Eagle; they are also nearly straight. The inner claws are the longest, and that excellent observer, Captain Vincent Legge, points out that they seem "especially adapted for the work of carrying off loose and fragile masses, such as the nests of small birds, as they would naturally form its chief means of grasp when such an object was being held by both feet during the process of flight." This last sentence gives an insight into the habits of the bird, which are on a par with its remarkable structure. It might well be called the "Bird's-nesting Eagle," for it seems to be the only bird of prey which systematically lives by the robbery of smaller birds' nests; only on very rare occasions, and when pressed by hunger, has it been known to attack larger game or worry the poultry-yard. It is almost always on the wing, and the Lepcha-hunters near Darjeeling speak of it as the bird "that never sits down." It is found in the Himalayas and in other wooded districts of India, and occurs but more sparingly in the Malayan peninsula and islands, ranging to some of the Moluccas, but probably visiting the latter only on migration. But it is in Ceylon that it is, perhaps, more plentiful than in any other locality, and the best account of its habits is that given by Captain Legge, whose words are subjoined. "This fine, long-winged Eagle is, on account of the singular structure of its feet and its curious habits, one of the most interesting, but, at the same time, perhaps the most destructive of raptors to bird-life in Ceylon. It subsists, as far as can be observed, entirely by birds'-nesting, and is not content with the eggs and young birds which its keen sight espies among the branches of the forest-trees, but seizes the nest in its talons, decamps with it, and often examines

* νέος, new; πούς, a foot: meaning that there was something novel and extraordinary about its foot.

the contents as it sails lazily along. Furthermore, Mr. S. Bligh informs me that he once found the best part of a bird's nest in the stomach of one of these Eagles which he shot in the Central Province. Its flight is most easy and graceful. In the early morning it passes much of its time soaring round the high peaks or cliffs on which it has passed the night, and about nine or ten o'clock starts off on its daily foraging expedition. It launches itself with motionless wings from some dizzy precipice, and proceeding in a straight line, till over some inviting-looking patna-woods it quickly descends with one or two rather sharp gyrations, through, perhaps, a thousand feet, and is in another moment gliding stealthily along just above the tops of the trees. In and out among these, along the side of the wood, backwards and forwards over the top of the narrow strip, it quarters, its long wings outstretched and the tips of its pinions wide apart, with apparently no exertion; and luckless indeed is the Bulbul, Oriole, or Mountain Finch whose carefully-built nest is discovered by the soaring robber." *

The size of the Kite Eagle is about thirty inches in length, and the colour is entirely black, with some indistinct bars of ashy-grey on the tail. Besides the Eagles that have been alluded to already, there are the Hawk-Eagles (*Nisaëtus*), remarkable for their long legs, and the Crested Eagles (*Spizaëtus*), which have a beautiful long crest hanging from the hinder part of the head.

THE COMMON HARRIER EAGLE (*Circaëtus* † *gallicus*).

This, which is also called the "Jean-le-Blanc," is one of the best-known of all the bare-legged section of the Eagles. The genus *Circaëtus*, to which it belongs, contains five species, of which four are peculiar to Africa, the *C. gallicus* being found all over Southern and Central Europe, and extending into India, where it is not at all unplentiful. In its nature this bird is rather sluggish, though in confinement it is very untamable, and wears a thoroughly fierce aspect, as could be seen by any one who examined the specimen in the Zoological Gardens. Its ferocious appearance was heightened by its peculiar eye, which is very large, of a bright yellow, with a very small black pupil, whereas the pupil in most birds of prey is rather large.‡

THE INDIAN SERPENT EAGLE (*Spilornis cheela*).

This is a beautiful bird, having the under surface mottled with white spots or "ocelli." All the Serpent Eagles, of which there are several species, are characterised by a similar style of plumage, and by a full, thick crest of feathers springing from the occiput and hind part of the head. They are found all over India and Ceylon, Southern China, and the Burmese countries, the Malayan Peninsula, Sunda Islands, Borneo, and Celebes. The Ceylonese species, which is a small race of the Indian bird, is stated by Layard to feed on Snakes, Lizards, and other reptiles and insects, and to be particularly partial to the large trees on the banks of tanks, from them swooping down on the frogs which came up to sun themselves on the floating logs or reeds. The Indian species of Serpent Eagle is a powerful bird, and is said to capture Pheasants during the breeding season and bring them to the nest. Mr. Hume has generally found small Snakes in their stomachs; once as many as fifty together were found, all scarcely bigger than large Worms; and an instance was brought to his knowledge of a Cobra some two feet and a half long having been found dead, but uninjured, in one of these birds' stomachs. Mr. Thompson, a frequent contributor to Mr. Hume's "Rough Notes," tells of one which he had alive, and which was kept along with two little Indian Owls (*Carine brama*), a Carrion Crow, and three large green Woodpeckers, and who killed and ate up every one of the latter, though well supplied with other fresh meat.

THE BATELEUR EAGLE (*Helotarsus* § *ecaudatus* ‖).

This is a very remarkable bird, which might also with propriety be called the Short-tailed Eagle, as it is the only species known in which the wings exceed the tail in length. It is found in Africa only, where it is by no means rare in the southern and north-eastern quarters of the continent.

* "Birds of Ceylon," p. 49.

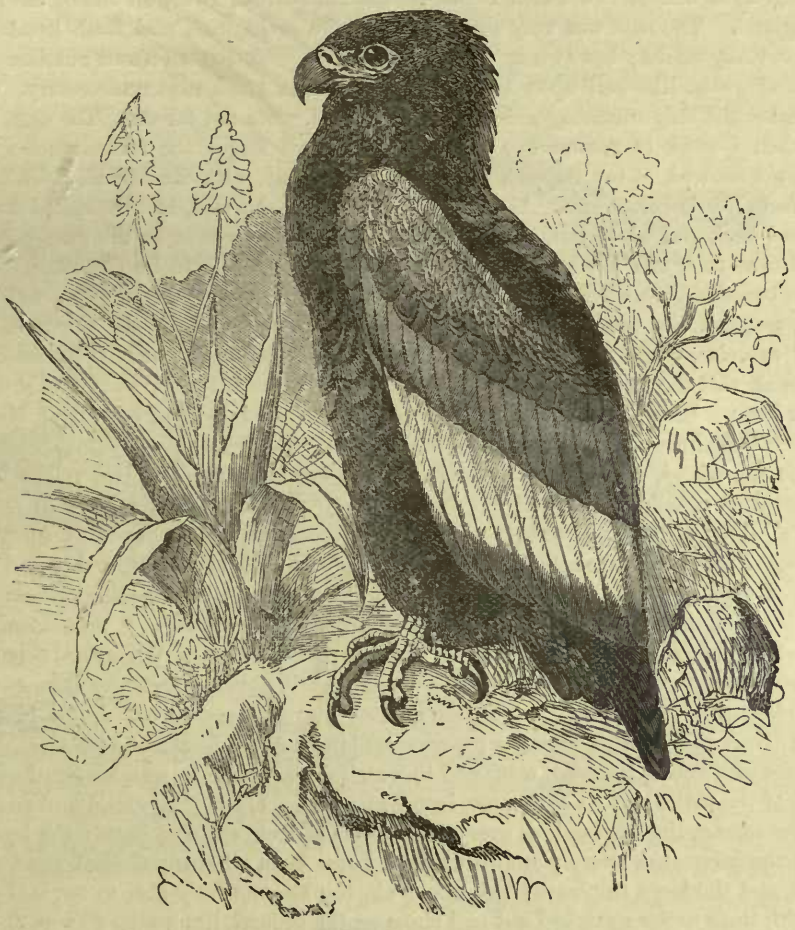
† κίρκος, a Harrier; ἀετός, an Eagle.

‡ Ibis, 1865, p. 253.

§ ἕλω (αἱρέω), to lift; ταρσός, a tarsus.

‖ Ecaudatus, Latin, meaning "without tail," on account of its shortness.

In Damara Land, according to Mr. Andersson, it builds its nest on trees, selecting generally one of such a terribly thorny nature that the nest is always difficult of access. Occasionally, however, a rock is selected for the breeding-place. When in captivity, this bird changes the colour of the face, exactly as the Brazilian Caracara already alluded to; the bare skin round the nostrils and eyes, which is generally brilliant coral-red, fading to pale orange-yellow.



BATELEUR EAGLE.

The Bateleur Eagle is about two feet in length, and has an enormous crest of plumes. The colour is black, with a large maroon-coloured patch on the shoulders and on the back, the tail being also of this colour. Sometimes individuals with pale, cream-coloured backs are found; but at present it is not known whether these are a different species, or whether they constitute only a pale variety of the ordinary Bateleur.

THE WHITE-TAILED EAGLE (*Haliaëtus albicilla* *).

Sea Eagles are absent from South America, but probably from no other country of the globe. Both Europe and North America are inhabited by large and powerful species; and throughout Africa and Madagascar the handsomely-marked species *H. vocifer* occurs. One of the most widespread is the White-bellied Sea Eagle; it is found round the coasts of Australia and all the Molucca Islands, ranging as far as India and Ceylon, and as high as Cochin-China.

The White-tailed Eagle, which, from its being an inhabitant of the British Islands, is the species most familiarly known of all the Sea Eagles, is still met with in some of the northern parts of

* ἁλιάετος, a Sea Eagle.

Scotland, and in the Hebrides; but as it is a bird which creates a good deal of havoc among lambs at certain periods of the year, the war of extermination which has been waged against it has now contributed considerably to the increasing rarity of the species on these coasts. The breeding of this Sea Eagle has been well described by Mr. Woolley.* He says:—"On the coasts, the Sea Eagle chooses a roomy and generally sheltered ledge of rock. The egg which Mr. Hewitson figures (Eggs, Br. B., ed. 3, pl. iv., fig. 2) is one of two which I took on the 23rd April, 1849, on one of the most northern points of our island. The nest was very slightly made of a little grass and fresh heather loosely put together, without any sticks; but two or three 'kek' stalks were strewn about outside. There was a good thickness of guano-like soil upon the rock, which made much nest unnecessary. Two or three Guillemot's beaks, the only unmanageable part of that bird, were not far off. The eggs were laid two days before when I went to reconnoitre; and I never shall forget the forbearance which a friend who was with me showed, at my request, as he lay, gun in hand, with the hen Eagle in full view upon her nest not forty yards below him. Her head was towards the cliff, and concealed from our sight; whilst her broad back and white tail, as she stood bending over her nest on the grassy ledge, with the beautiful sandstone rock and sea beyond, completed a picture rarely to be forgotten. But our ears, and the air we breathe, give a finish to Nature's pictures which no art can imitate; and here were the effects of the sea, and the heather, and the rocks, the fresh warmth of the northern sun, and the excitement of exercise, while the musical yelping of the male Eagle came from some stand out of sight. Add to all this the innate feeling of delight connected with the pursuit of wild animals, which no philosopher has yet been able to explain further than as a special gift of our Great Maker, and then say whether it is not almost blasphemy to call such a scene a 'picture!' Upon this occasion, I made some remark to my friend, when the hen Eagle showed her clear eye and big, yellow beak, her head full of the expression of wild nature and freedom. She gave us a steady glance, then sprang from the rock, and with 'slow winnowing wing'—the flight-feathers turning upwards at every stroke—was soon out at sea. Joined by her mate, she began to sail with him in circles farther and farther away, till quite out of sight, yelping as long as we could hear them, Gulls mobbing them all the time. To enjoy the beauties of a wild coast to perfection, let me recommend any man to seat himself in an Eagle's nest. The year before this I took the young ones out of the same eyry late in July. It was my first attempt at an Eagle's stronghold, and I shall never forget the interest of the whole affair; a thunderstorm coming on just before, making it necessary to cut drains in the peat with our knives, to divert the torrents of water; our councils about the best mode of attaching the ropes; the impertinence of a young lad who, stationed to watch for my signals, was rendered quite useless by his keen sense of the ridiculous on seeing me, in my inexperience, twisting round and round at the end of the rope; the extraordinary grandeur everything assumed, from the nest itself; the luxurious feeling of exultation; the interest of every plant about it—I know them all now; the heaps of young Herring-Gulls' remains, and the large fish-bone; but, above all, the Eaglets fully able to fly, and yet crouching side by side, with their necks stretched out and chins on the ground, like young Fawns, their frightened eyes showing that they had no intention of showing fight.

"Very gently, as a man 'tickles' trout, I passed my hand under them, and tied their legs together, and then tried to confine their wings. They actually allowed me to fasten a handkerchief round them, which, however, was soon shaken off when they began to be pulled up. When the men had raised me, the string attached to my waist lifted one Eaglet, and presently the second came to the length of his tether. Great was the flapping of wings, and clutching at rocks and grass. I had many fears that the string or the birds' legs must give way; but, after much hard pulling, I got them safely to the top, and they are now (1853) alive at Matlock amongst rocks, where I hope they may breed; but, though five years old this season, they have not yet quite completed the adult plumage. Their dutiful parents never came near them in their difficulties; but I am happy to say that in 1850 (the year after I took their eggs), they carried off their young, through the interest I was able to exert in their favour. They had shifted their position; and they changed again in 1851 to a rock with an aspect quite different, and more than a mile away. In 1847, to please the shepherds, the young were shot in the nest, which was built in the spot where I visited it the two following years. There was no sea-weed about this nest either time that I saw it; but a friend writes me word, that two which

* "Ootheca Woolleyana," p. 47.

he examined last year on the sea-cliffs of this island, and which he carefully described to me, were principally made of that material, as Mr. Hewitson also had found them in the Shetland Islands. On one of these two occasions, the old Eagle made a dash near my informant, with a 'fearful scream,' and such was the tremendous character of the rocks, that his 'hair gets strong' when he thinks of them. These two nests, both occupied, were not more than a mile and a half apart."

WHITE-TAILED EAGLE.

THE SWALLOW-TAILED KITE (*Elanoides furcatus*).

The forked tail which is characteristic of the Kites reaches in the present species its greatest development, so that the name of Swallow-tailed Kite is by no means inappropriate. On five occasions the bird has been captured in England, and it is doubtless during its migration that the bird is driven to Britain by some adverse wind. Its range is extensive, as it is numerous during the summer in some of the southern States of North America, and it migrates to South America, whence it frequently appears in collections from Brazil and Columbia. Mr. Audubon gives the following account of the Swallow-tailed Kite :—"The flight of this elegant species of Hawk is singularly beautiful and protracted. It moves through the air with such ease and grace, that it is impossible for

any individual, who takes the least pleasure in observing the manners of birds, not to be delighted by the sight of it whilst on the wing. Gliding along in easy flappings, it rises in wide circles to an immense height, inclining in various ways its deeply-forked tail, to assist the direction of its course; dives with the rapidity of lightning, and, suddenly checking itself, re-ascends, soars away, and is soon out of sight. At other times, a flock of these birds, amounting to fifteen or twenty individuals, is seen hovering around the trees. They dive in rapid succession amongst the branches, glancing along the trunks, and seizing in their course the insects and small lizards of which they are in quest. Their motions are astonishingly rapid, and the deep curves which they describe, their sudden doublings and crossings, and the extreme ease with which they seem to cleave the air, excite the admiration of him who views them while thus employed in searching for food.

"In the States of Louisiana and Mississippi, where these birds are abundant, they arrive in large companies in the beginning of April, and are heard uttering a sharp plaintive note. At this period I generally remarked that they came from the westward, and have counted upwards of a hundred in the space of an hour, passing over me in a direct easterly course. At that season, and in the beginning of September when they all retire from the United States, they are easily approached when they have alighted, being then apparently fatigued, and busily engaged in preparing themselves for continuing their journey, by dressing and oiling their feathers. At all other times, however, it is extremely difficult to get near them, as they are generally on wing through the day, and at night rest on the highest pines and cypresses, bordering the river-bluffs, the lakes, or the swamps of that district of country.

"They always feed on the wing. In calm and warm weather they soar to an immense height, pursuing the large insects called *Musquito Hawks*, and performing the most singular evolutions that can be conceived, using their tail with an elegance of motion peculiar to themselves. Their principal food, however, is large Grasshoppers, Grass Caterpillars, small Snakes, Lizards, and Frogs. They sweep close over the fields, sometimes seeming to alight for a moment to secure a Snake, and holding it fast by the neck, carry it off, and devour it in the air. When searching for Grasshoppers and Caterpillars, it is not difficult to approach them under cover of a fence or tree. When one is then killed, and falls to the ground, the whole flock comes over the dead bird, as if intent upon carrying it off. An excellent opportunity is thus afforded of shooting as many as may be wanted; and I have killed several of these Hawks in this manner, firing as fast as I could load my gun.

"The Fork-tailed Hawks are also very fond of frequenting the creeks, which, in that country, are much encumbered with drifted logs and accumulations of sand, in order to pick up some of the numerous Water-snakes which lie basking in the sun. At other times they dash along the trunks of trees, and snap off the pupæ of the Locust, or that insect itself. Although when on the wing they move with a grace and ease which it is impossible to describe, yet on the ground they are scarcely able to walk.

"I kept for several days one which had been slightly wounded in the wing. It refused to eat, kept the feathers of the head and rump constantly erect, and vomited several times part of the contents of its stomach. It never threw itself on its back, nor attempted to strike with its talons, unless when taken up by the tip of the wing. It died from inanition, as it constantly refused the food placed before it in profusion, and instantly vomited what had been placed down its throat."

THE COMMON KITE (*Milvus ictinus**).

Times have changed in England since the number of Kites to be seen flying about London Bridge could form a subject of astonishment to a foreign traveller visiting that country; but less than three hundred years ago this was the case, though now the species has been all but banished from the land. It may still occasionally nest in some parts of Wales and of Scotland; but in the latter country places where formerly the species bred plentifully now know it no more. The Kite builds its nest of sticks on a large tree, but occasionally also on rocks, and it is generally composed of a mixture of materials, such as bones, &c., and the lining usually contains a good many rags; so that Shakspere, with the knowledge of natural history which always distinguished him, was quite right when he said—

"When the Kite builds, look to lesser linen."

* ἰκτῖνος, a Kite.

The presence of the Kite in London was useful in the old days, as its food consists by preference of offal, though it also devours Moles, Frogs, and unfledged nestlings, Rabbits, Snakes, and fish. The forked tail of this species—which serves as a rudder to the bird when flying, as it often does, in circles aloft—easily distinguishes it from all other British birds of prey. The length of the bird is about two feet, and the general colour of the upper plumage is rufous, most of the feathers being edged with that colour. Below, it is rufous-brown, with a narrow streak of blackish down the feathers; the quills are black; the tail rufous-brown, deeply forked, and crossed with seven or eight bars of black. The species is found all over Europe, but becomes gradually rarer in the eastern parts.

COMMON KITE.

THE EUROPEAN HONEY-KITE (*Pernis apivorus*).

This bird is generally known as the Honey-Buzzard, though from the reticulations on the hinder aspect of the tarsus it has evidently nothing to do with those birds, even if its soft and kite-like plumage did not show its affinities to the Kites. Its nostril is also peculiar, and is closed in by a membrane, which doubtless forms a protection from the stings of insects when the bird is attacking a Bee's or Wasp's nest. Its habits have been well described by Brehm.* This bird is, perhaps, the most timid of all European birds of prey, but is remarkable for its good temper. Its movements are in the highest degree clumsy; its flight is bad, heavy, and slow, and is generally a short one, and the bird shows a great disinclination to rise to any considerable height in the air; in short, its whole bearing evinces the most lazy disposition. It will sit for hours on a stone boundary wall, on a solitary tree or sign-post, or on some other elevated spot, quite contented, watching its prey, which consists of the following:—Insects of all descriptions, Beetles, Caterpillars, Dragon-flies, Gadflies, Worms, Frogs, Snakes, Lizards, and destructive Rodents, which form its principal food; besides which it is very fond of hunting for the nests of the Humble-bee and Wasp, and of feeding on their larvæ. This bird also, unfortunately, destroys the young, and especially the eggs, of such of the smaller birds as it comes across while hunting for insects; this causes it to be looked upon as a disagreeable and hateful enemy by all birds. Crows and Rooks mob the Honey-Buzzard with almost the same eagerness as they chase the Eagle-Owl, and all small birds make a great noise at its appearance. In the summer it also feeds on buds, blossoms, bilberries, other wood-berries, and even leaves. This habit distinguishes it from all other German birds of prey.

"The Honey-Buzzard reaches us somewhat late in the year, and commences to build its nest when the other Raptors have hatched their broods. The nest is very flat, and is placed on the highest of our forest trees; it is principally constructed of green twigs, mixed with dead sticks, and is lined with moss, hair, and feathers. It generally contains three eggs, of a rusty

* "Bird-life," p. 543.

yellow ground, very thickly blotched and spotted with dark reddish-brown. They are somewhat small and rather long in shape. Of these rarely more than two are hatched. The young ones are at first fed with Caterpillars, Flies, Beetles, Worms, &c., which the old birds collect in their crops, and then throw up; later they are treated to pieces of Wasps' nests filled with larvæ, Frogs, Mice, young birds, &c. The parent birds still continue to feed their young long after the latter have left the nest. Both young and old birds remain in company almost till the moulting season comes round, when they migrate more to the southward."

The Honey-Kite inhabits, during the summer, the greater part of Europe, and flies away to Africa to pass the winter. In India it is represented by a species which goes through similar changes of plumage, but may always be recognised by its long crest. The phases through which the Honey-Kite passes are most remarkable, the bird being sometimes nearly all white, at other times all black; and this plumage seems to occur at any age, sometimes in youth, sometimes in old age; and hence this is called a melanism (μέλας, black). Many birds of prey are subject to this melanism, but none more so than the Honey-Buzzards, and their representatives in America, the Tooth-billed Kites (*Leptodon*).

ANDERSSON'S PERN (*Machærhamphus* * *Anderssoni*).

This remarkable bird bears the name of one of the most intrepid, as well as one of the most unassuming, of African travellers, the late Charles John Andersson, who discovered it during his residence in Damara Land in South-western Africa. So rare is it, and so difficult to obtain, that he only managed to procure two specimens in the space of ten years, though constantly on the look-out for the bird. He writes concerning it:—"On the 10th of March, 1865, I obtained one specimen, a female, of this singular bird at Objimbinque, Damara Land. It was shot by my servant, who observed another, probably the male. I imagine that I have myself observed it once or twice in the neighbourhood of Objimbinque just before dusk. When brought to me I instinctively suspected the bird to be a feeder at dusk or at night, and called out, 'Why, that fellow is likely to feed on Bats!' And truly enough so it turned out; for on dissection an undigested Bat was found in the stomach; and in another specimen, subsequently killed by Axel, there were several Bats in the stomach."† It is probably owing to this habit of feeding in the evening that the bird is so difficult to procure, as is the case with many of the Goat-suckers, which are also night-feeding birds. Since Mr. Andersson's death, two or three specimens of his Pern have been sent from Madagascar, but in the intervening portions of the African continent it is as yet unknown.

The colouring of this species is plain, being of a chocolate-brown colour, with a long crest springing from the back of the head; above the eye is a white spot, and another below the eye; the throat and chest are white, with a streak of dark brown down the centre of the throat; the quills and tail are banded the bars showing paler below. The length of the bird is about seventeen inches.

Only one other species of the genus *Machærhamphus* is known, and this is Westermann's Pern (*M. alcinus*), which is an inhabitant of Malacca, where it is almost as rare as Andersson's Pern is in Africa. It has lately been sent from South-eastern New Guinea, and may ultimately be found to inhabit some of the Moluccas.

THE FIFTH SUB-FAMILY.—THE FALCONS (*Falconinæ*).

In all the true Falcons and in the allied genera the bill, which was simply festooned in the Eagles, Kites, and Buzzards, becomes very distinctly toothed, and in some genera even two teeth are present. In these birds, too, the cere is strongly shown, and is generally of a bright yellow colour.

THE CUCKOO-FALCONS (*Baza*).

These birds have the soft plumage of a Honey-Kite, and yet possess the toothed bill of a Falcon, so that they are placed among the Falconinæ; but, because of their Kite-like plumage, they follow close to the Perns and Honey-Kites. They not only possess the usual tooth of the Falcon's bill, but a second is actually present, so that there is no difficulty in recognising a member of the genus *Baza*.

* μάχαιρα, a sharp knife; ῥάμφος, a bill.

† Andersson's "Birds of Damara Land." Edited by J. H. Gurney, 1872, p. 22.

The American Cuckoo-Falcons (*Harpagus*) are the only other birds of prey which have a double-toothed bill.

The name of "Cuckoo"-Falcon has been given to these birds on account of their actual resemblance to a Cuckoo, in the grey colour of the back with the reddish bars on the under surface. They have also a very large yellow eye. The distribution of the genus *Baza* is singular, and it is one of those forms which does not occur in Europe, but exhibits the affinity which is often seen between certain African and Indian birds. About nine different kinds are known, each having its own limited range. Thus Swainson's Cuckoo-Falcon (*B. cuculoides* *) is found in the forest country from Senegambia to Gaboon in West Africa, and is replaced by *Baza Verreauxi* in the forests of Natal. In Madagascar a third species (*B. madagascariensis*) occurs, and on crossing the Indian Ocean a fourth kind (*B. ceylonensis*) is found inhabiting Ceylon. Malacca and the Sunda Islands have their own *Baza sumatrensis*, the Philippines *B. magnirostris*, the island of Celebes *B. erythrothorax*, the Moluccas and New Guinea *B. Reinwardti*, and Northern Australia, *B. subcristata*. None of these birds appear to be migratory, and their geographical distribution is interesting when traced out on a map of the world.

From their shy and retiring habits, but little has been recorded of their life. Verreaux's Cuckoo-Falcon is said to frequent the dense bush in Natal, and Captain Harford shot one in that country while engaged upon an ant-hill, and their food appears to consist of Grasshoppers and Mantidæ, while another observer took from the stomach of one of these birds remains of a green Mantis, of Locusts, and of a Chameleon. This species is one of the largest of the Cuckoo-Falcons, measuring seventeen inches in length, and the colour is dark ashy-grey; deeper ash-colour on the head and crest; the sides of the face, throat, and chest, are clear ashy; the breast white, banded across with pale rufous brown; the under tail-coverts being pure white; both the wings and tail are barred with dark brown. The sexes of these birds differ very little in size.

THE FALCONETS (*Microhierax*†).

This name is applied to a genus of tiny Falcons, which are peculiar to the Indian region. One of them, the Indian Falconet (*Microhierax cærulescens*), is found in the Himalayas and the Burmese countries. A second one is peculiar to Assam, a third to the Philippine Islands, and a fourth to the interior of China, while the fifth and remaining species is found in the Malayan Peninsula and the Sunda Islands.

Not one of these little Hawks is seven inches in length, and even to this day there are many authors who think that they are Butcher-birds or Shrikes, and not Hawks at all. They are, however, true Falcons, though of very small size, and are said to be used by native chiefs for hawking insects and Button-quails, being thrown from the hand like a ball; but this story has been discredited of late, the Besra, a small Sparrow-Hawk, being probably the bird alluded to. The Falconets are known to sit solitary on high trees, and according to native accounts they feed on small birds and insects.

THE PEREGRINE FALCON (*Falco peregrinus*‡).

This noble bird justifies his name of *peregrinus*, by his distribution over the earth's surface. The ordinary Peregrine, which is still found in suitable places breeding on British coasts, is met with all over Europe and Northern Asia, ranging into South Africa and India in winter, extending throughout China to the Sunda Islands, and the Philippine Archipelago. In North America he is also widely distributed, and is as plentiful as in Europe. In the southern hemisphere the Peregrines, though strictly of the same type as the European bird, are always darker in colour, and have blacker faces and heads. The Australian Peregrine is called *Falco melanogenys*,§ and extends its range from the Australian continent to New Caledonia and the New Hebrides, and as far north as Java. In South Africa the resident Peregrine is a very small, dark-coloured bird, and is called *Falco minor*. This species is also met with in North-eastern Africa, and even ranges into the Mediterranean, as it has been shot in Rhodes, Sardinia, and Morocco. Again, in Chili, another dark-faced form occurs, the *Falco nigriceps*,‖ not unlike its Australian relative.

To write a history of the Peregrine Falcon would be almost to write a history of falconry, and

* Lit., like a Cuckoo. † μικρός, small, tiny; ἱέραξ, a Hawk. ‡ A wanderer.
§ μέλας, black; γένυς, a cheek. ‖ *Nigriceps*, black-headed.

although it would be beyond the limits of the present work to enter deeply into the subject, a few words must be said about it here. The art of falconry probably came from the East, where it is still practised, and an ancient bas-relief was found by Sir Austen Layard, among the ruins of Khorsabad, depicting a falconer with a Hawk on his wrist, thus proving the antiquity of the pursuit. In Great Britain it was formerly much in vogue, and in Salvin and Brodrick's work on "Falconry in the British Islands" there will be found an interesting *résumé* of the art, as performed in Great Britain, from ancient times down to the present. It is lamentable to think of the way in which these noble birds, once the pride and favourite of monarchs, are now shot down and classed as vermin. The strict way of preserving game which has been common of late years, and the general use of firearms, have, no doubt, been the chief causes of the destruction of the larger Falcons, and it will take some time to disabuse the vulgar prejudices of gamekeepers, and of some proprietors, as to the mistake that is made in killing off every kind of raptorial bird indiscriminately. A protest which was penned by Mr. G. E. Freeman, in his "Falconry," is worthy of reproduction here:—"All Hawks, when they have a choice, invariably choose the easiest flight. This fact is of the last importance in the matter before us. I confess that I at once give it the chief place in this argument. Who has not heard of the Grouse disease? It has been attributed, sometimes respectively, and sometimes collectively, to burnt heather; to heather poisoned from the dressings put on Sheep; to the Sheep themselves cropping the tender shoots and leaves of the plant, and thus destroying the Grouse's food; to the tape-worm; to shot which has wounded but not killed; and perhaps to other things besides. It may be, I doubt not, correctly referred to any or to all of these. Of this, however, there appears no question that from whatever cause it springs it is *propagated*. A diseased parent produces a diseased child. Now, I say that when every Hawk is killed upon a large manor, the balance of Nature is forgotten, or ignored; and that Nature will not overlook an insult. *She* would have kept her wilds healthy; destroy her appointed instruments, and beware of her revenge!"

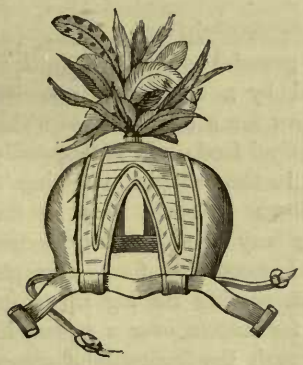
PEREGRINE FALCON.

The Peregrine Falcon has always been celebrated with falconers for its superior dash and courage. The female is much the larger and more powerful bird, and is called the "Falcon," the male being known as the "Tiercel." The young birds reared from the nest are called "Eyes," and the immature specimens, from their more rufous colour, are distinguished as the "Red Falcon" and the "Red Tiercel." When a bird has been caught wild in the full plumage it is called "Haggard." The principal flight of the "Falcon" was at the Heron, and many anecdotes are told of the encounters between these two antagonists in mid-air. The evidence of Falconers, however, goes to show that the impalement of the Hawk by the Heron's bill is a rare occurrence, and it is only when the birds come to the ground that the presence of the man is required to rescue the Falcons from their dangerous foe. The Heron, on being pursued, endeavours to avoid his pursuer by mounting high into the air, the Falcon meanwhile doing his best to rise above him and strike the quarry to the ground. Generally,

two Falcons were employed in the chase, and while the Heron avoided the stoop of one by changing his position suddenly, the other was ready to stoop from above, until, by a successful swoop, the Heron would be mastered and borne to the ground with the two Falcons in close embrace. Then was the time for the good falconer to be at hand to save his Hawks from the Heron. In a wild state the Peregrine feeds on Grouse of all kinds, Pheasants, Partridges, Ducks, Pigeons, Plovers, &c., but it does not so often visit the poultry-yard as the other Hawks, preferring the open country or the sea-coast. In this latter locality, the Falcon feeds on the various sea-birds, such as the Puffins, Auks, Guillemots, and as it flies back to its nest with food for its young, it will sometimes in very wantonness rip up a Gull or other sea-bird if it happens to get in the way as it rushes by. The nest is generally large, and composed of sticks and herbaceous plants, excepting in localities were none of the latter exist, when it is made of grass. The site chosen is some sea-cliff or high precipice inland, where there is sure to be some difficulty in reaching the nest, which is generally harried by means of a rope. They build in the same localities for years together, and Professor Newton gives an interesting record of such an occurrence,* when he mentions a hill in Lapland, where a pair of Falcons had a nest when it was visited by the French astronomical expedition in 1736, a nest being re-discovered in the same place in 1799 by Captain Skjöldebrand, and again by the late Mr. Woolley, in 1853. Near the site of its nest the Peregrine brooks no intruder, and will even attack an Eagle, an instance having been recorded of one of the latter birds being stunned and brought to the ground by a Peregrine, who broke its own wing in the attempt, and was liberated by the shepherds to mend its wing as best it could, in gratitude for having delivered their aquiline enemy into their hands.

HOODED FALCON.

In Holland, where until recent years hawking was largely carried on under the auspices of the king, there is a well-known place, called Valkenswaard, where a good many Hawks are trapped every autumn during migration, and it is from the neighbourhood of this village that many of the most celebrated falconers have come. At the same time England has also produced many celebrated adepts at the art, which is generally carried on from father to son; and one of the Barr family, with a high reputation as a falconer, a few years ago exhibited his trained birds in the neighbourhood of London. The writer has also seen some fine sport in Huntingdonshire, with Lord Lilford's Hawks, in a large extent of open country near Great Gidding.



FALCON'S HOOD.

The male Peregrine is of a bluish-grey colour, narrowly barred with black, the wings darker; the cheeks, ear-coverts, and moustache, black, the entire sides of the head being sometimes of this dark aspect; underneath, the body is white, with more or less of a reddish tinge, and crossed with black bars; tail grey, broadly barred with black and tipped with white. The length is about fifteen inches, that of the female about seventeen; and the wing is fourteen inches and a half in length instead of about twelve, as in the male. In plumage the hen bird is very similar, but is generally of a richer rufous hue below.

Besides the Peregrine Falcons there are a host of smaller species of the genus *Falco*, varying much from the above birds in size and style of colour, but of exactly the same form, and having much the same habits. The Hobby (*Falco subbuteo*) and the Merlin (*F. æsalon*) represent these smaller Falcons in the British Islands.

* "Ootheca Woolleyana," p. 93.

THE GREENLAND JER-FALCON (*Hierofalco candicans*).*

Besides the Peregrine, there were used in falconry, in England, the Noble, or Jer-Falcons, birds which were much prized, although they did not possess the same fire and dash in pursuit of their quarry exhibited by the former bird. There are five distinct kinds of these northern Jer-Falcons, without mentioning the Saker Falcon of South-eastern Europe, which also belongs to the genus *Hierofalco*. The best known is the Greenland Jer-Falcon, which, as its name implies, is an inhabitant of Greenland and North America, young birds only occurring in the British Islands during migration. This species is nearly pure white in colour when fully adult, the back and wings retaining small spots of black, the entire head and breast, and especially the tail, becoming pure white as the bird gets older and loses the spots and bars which characterise its immature dress. An unfailing mark by which a Greenland Jer-Falcon can be told at any age is the light yellowish bill and cere, and the absence of arrow-shaped bars on the flanks, which in young birds are longitudinally streaked with brown, but are never barred. All the other Jer-Falcons have distinct bars across the flanks, as well as bluish bills and regularly barred tails. They are four in number, the Norway Jer-Falcon (*H. gyrfalco*), the Iceland Jer-Falcon (*H. islandicus*), Holböll's Jer-Falcon (*H. holbölli*), and the Labrador Jer-Falcon (*H. labradorus*). They are nearly all peculiar to the countries whose names they bear, the Norway bird not occurring anywhere out of Europe and Northern Asia, one specimen having been known to occur in England; it seems also to emigrate to Central Asia, as a single bird was procured during the last Yarkand Mission. All the Jer-Falcons have shorter toes than the Peregrines, in which the outer toe is very long, while in the other birds the outer and inner toes are about equal in length.

When in a wild state the Greenland Falcon feeds upon Ptarmigan, Geese, and on the sea-birds which frequent the cliffs where it takes up its abode. It evinces great courage in defending its nest.

THE KESTRELS (*Cerchneis*).

These form a group of short-toed Hawks, like the foregoing, but are much more numerous in species, and are found distributed all over the world, with the exception of some of the Oceanic Islands. More than twenty different kinds of Kestrel are recognised by naturalists, and they are more insect-feeding birds than the bolder and nobler Falcons which have just been spoken of. The commonest and best known of all is

THE COMMON KESTREL, OR WIND-HOVER (*Cerchneis tinnunculus*).†

This species gains its name of Wind-hover from a very pretty and graceful action with which it hangs suspended in the air, as if by a thread, keeping itself balanced by a constant winnowing of the air by its wings, and from this position it scans the ground below for a stray Mouse which may venture out of its hole, for mice and small birds constitute its principal food. It is frequently to be seen in the autumn hovering about a field of sheaved corn in the twilight, selecting a position about forty feet in the air, and occasionally stooping down on some prey in the stubble below. Should it not succeed in its pounce, it flies a little way in a few easy circles, and again commences to hover over a new part of the field. Insects also form a staple article of food to the Kestrel, who devours them while in full flight, passing its leg up to its bill, and the author has met with an instance of a Kestrel hawking for insects over a stream in the late evening. This Hawk is, unfortunately, often confounded through the ignorance of game-keepers with the Sparrow-Hawk, and suffers consequently for the misdeeds of the latter, a fact much to be regretted, for it is a very useful bird, owing to the number of mice it destroys; indeed, a writer in Macgillivray's "British Birds" computes that a single Kestrel would destroy upwards of ten thousand mice during its stay in Britain. It will also catch birds, but in limited numbers, and then generally only during the breeding season, when its young require constant food. Although of a less ferocious nature and aspect than the Falcons, the Kestrel, nevertheless, often shows forth his accipitrine temperament in a way that would scarcely be expected from his mild-looking dark eye,

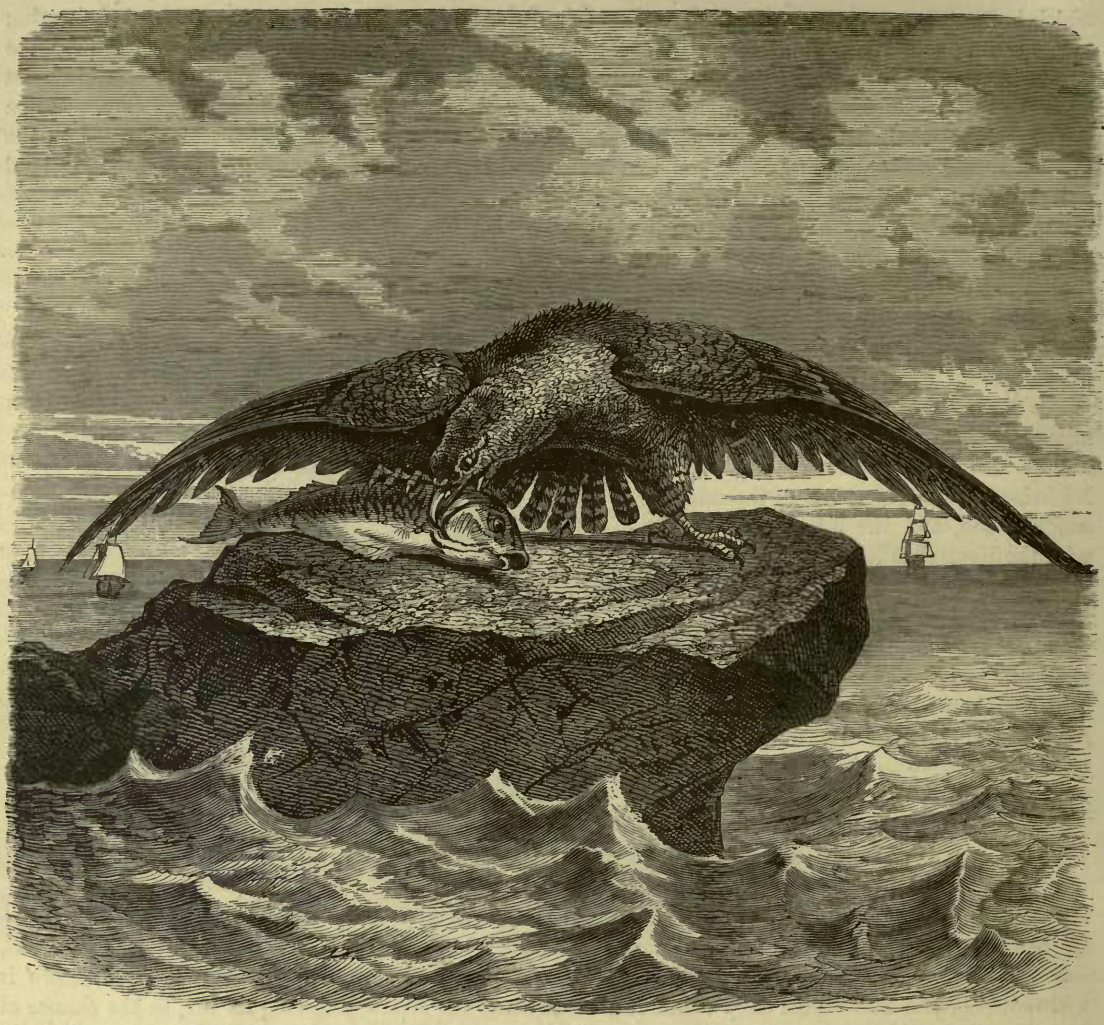
* ἱερός, sacred; *falco*, a Falcon; *candicans*, white. † κερχνηΐς, or κέρχνη, Gr., a Kestrel; *tinnunculus*, Lat., a Hawk.

which has nothing of the ferocity of the yellow iris of the Sparrow-Hawk. Some young birds belonging to the writer, consisting of three females and a male, being left without food for a few hours by the person in whose charge they were placed, forgot their fraternal affection, and the larger hen birds set upon the male, who was not so large or strong as they were, and devoured him completely. When shooting in a sandy island near Heligoland also, the writer wounded a Dunlin, which floated on the water a considerable distance out at sea, and whilst waiting for the waves to bring the bird in to land a Kestrel hove in sight and made a swoop at the Dunlin, which the latter avoided by a rapid dive. Twenty-three times the Hawk repeated the manœuvre without success, until the poor little wader became exhausted, and was borne in the talons of his relentless foe towards the rock of Heligoland, about a mile off. This action had been witnessed also by Messrs Seebohm and Nicholson, from other parts of the same sandy island, and the latter kept pace with the Kestrel as it skirted the beach, in the hopes that it might cross the island, when a shot would perhaps have caused the bird to drop his exhausted quarry. The Hawk, however, kept well out at sea, and regained his rocky home, though he was several times seen to pause in his flight and take a tighter grasp of his victim.

COMMON KESTREL.

The nest of the Kestrel is often placed in towers and old buildings, and the bird is sometimes to be seen round the Nelson monument in Trafalgar Square, but a tree is more frequently the site selected, when an old Crow's or Raven's nest is often chosen. The hen bird, as is the case with most Hawks, sits very close, and will often require a stick or stone to be thrown close to the nest before it will move off, and the sudden drop which it gives is often the means of saving its life, as the chance of a successful shot is difficult. The eggs are from four to six in number, and are rather handsomely coloured, being blotched with rufous on a white ground, and are not unfrequently entirely rufous.

In most of the Kestrels the sexes differ conspicuously in colour, the females being barred. This is the case in the common species, where the male has a blue head and tail. In the size of the sexes there is little or no difference, each measuring about twelve inches and a half. In winter, when there are fewer mice and beetles about, the Kestrel shifts his quarters, and becomes to a certain extent migratory: at this season of the year it visits India and Africa, not extending, however, so far down the latter continent as some of the European birds go. It is abundant at certain seasons in north-eastern Africa and Senegambia, but seldom goes as far as the Cape. The most easterly occurrence that is known of the Common Kestrel is the island of Borneo, though it is a common bird in China. It should be mentioned, however, that the Kestrel is always darker in colour from Japan and China, so much so that many naturalists consider it to be a distinct species from the British bird.



OSPREY.

THE SECOND SUB-ORDER.—PANDIONES.

CHAPTER VI.

THE OSPREYS AND OWLS.

THE OSPREY—Distribution—Food—How it Seizes its Prey—Nesting Communities—STRIGES, or OWLS—Distinctions between Hawks and Owls—Owls in Bird-lore and Superstition—Families of the Sub-order—THE FISH OWL—PEL'S FISH OWL—The EAGLE OWL—Dr. Brehm's Description of its Appearance and Habits—THE SNOWY OWL—HAWK OWLS—PIGMY OWLETS—THE SHORT-EARED OWL—THE LONG-EARED OWL—THE BARN OWL—The Farmer's Friend—Peculiar Characters—Distribution.

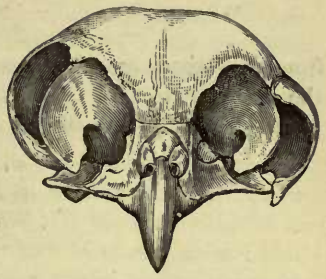
THE OSPREY, OR FISHING EAGLE (*Pandion haliaëtus*).

THE Osprey is one of the most cosmopolitan of the birds of prey, being found all over the world, with the exception of the continent of South America and some of the Pacific Islands. Specimens from Australia and the Moluccas are generally smaller than those from Europe or America; but as the size of the species appears to vary in different localities, the Australian form cannot be considered other than a permanently smaller race. Everywhere the habits of the Osprey seem to be very similar, the bird never being found away from the vicinity of water, unless it be sometimes during the breeding

season, when it makes its nest at some distance from its feeding haunts. Its food consists entirely of fish, and it is capable of carrying off one of considerable size; in the capture of its prey it is greatly aided by its reversible toes, and by the roughness of the sole of the foot, which is covered with minute spikes, and these are, of course, of great assistance to the bird in holding such a strong and slippery prey as a large fish often proves to be. Professor Newton writes of one living in the Zoological Gardens, that "when a fish was given to it, it was observed to seize it across the body, placing the inner and outer toes at right angles with the middle and hind toes, and, digging in the claws, it held the fish most firmly by four opposite points, not relaxing its hold or altering the position of the toes, but picking out the portions of flesh from between them with great dexterity." Occasionally, the Osprey attacks a fish beyond its strength, and it is then drawn under the water, and drowned. Mr. Dresser saw this happen in the Bay of Fundy, when a Fish Hawk was unable to release itself from a heavy fish, and, after being dragged under the water time after time, was ultimately carried out to sea, and disappeared. Mr. Collett, of Christiania, tells us that in one of the Norwegian lakes a huge Pike was caught, with the remains of an Osprey's skeleton still attached to its back. Sometimes, on landing its prey, the bird is unable to extricate its talons, and is captured alive. The nest of the Osprey is a large structure, and is variously situated, according to the nature of the locality. It is generally placed on a tree; but in situations where there are no trees the position chosen is on a large rock or stone, very often on the islands in the middle of the lakes which it frequents. The eggs are generally three in number, sometimes four, and are very beautiful, varying from a rich red to a buffy-white colour, with large reddish and brown markings. In Europe it is found nesting invariably in pairs, but in North America large communities are found; and Dr. Brewer relates that sometimes as many as "three hundred pairs have been observed nesting on one small island; and when a new nest is to be constructed, the whole community has been known to take part in its completion. They are remarkably tolerant towards smaller birds, and permit the Purple Grakle (*Quiscalus purpureus*) to construct its nests in the interstices of their own."

THE THIRD SUB-ORDER.—STRIGES, THE OWLS.

The principal distinctions between Hawks and Owls (*Striges*) have been already pointed out (p. 255); but there are still some other smaller characters to which a passing allusion must be made. It would be difficult, for instance, for the merest novice in the study of ornithology to mistake an Owl, when seen alive in a cage, or even in a case of stuffed birds, its enormous head and short neck being unlike those of any of the other birds of prey. The neck of some Owls is, indeed, so short and contracted, that it is with difficulty that any intervening curve between the nape and the back, which would mark a perceptible neck as in most Hawks, can be detected. Again, the Owls have their eyes directed forwards, so that they confront the spectator; while most of the other birds of prey turn their head more or less on one side when their attention is diverted, and do not look one straight in the face as an Owl does. The cere is almost always hidden by bristles in the *Striges*, and the latter have a very distinct facial disc, surrounded by a curious ruff, somewhat similar to that of the Harriers (*Circus*, p. 268), and Harrier-Hawks (*Micrastur*, p. 270). The external ear-opening is a complicated organ in the Owls, and differs considerably, the orifices often being of different form on either side of the head; and in one species, Tengmalm's Owl (*Nyctala tengmalmi*), the ear-openings are of different shape in the skull itself.



SKULL OF TENGMALM'S OWL.

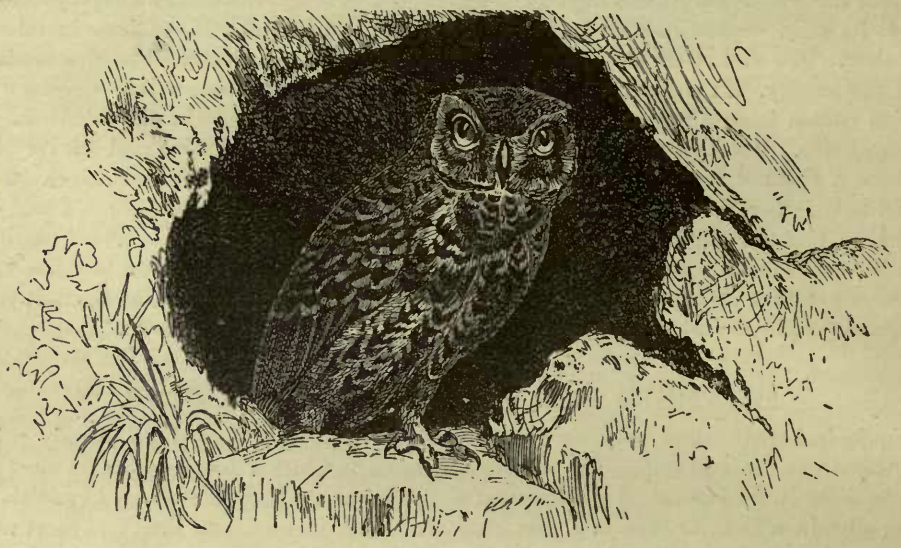
To those interested in bird-lore, a most entertaining study might be afforded by tracing the superstitions with which Owls have been regarded in all countries, and in the earliest times. Such a study was begun by the late Mr. Broderip, in his "Zoological Recreations,"* where he quotes from the ancient writers many passages, which show that Owls were as much regarded as birds of ill-omen by the inhabitants of Greece and Italy in olden times as they have been in England up to the present

* pp. 82, 95.

day. Nor is the infatuation confined to Europe, as later on are quoted instances of superstitious dread of the Owls in Morocco and West Africa; while they are equally held in fear in many Eastern countries.

The Athenians alone seem to have had a regard for these birds, and an Owl is found on the reverse side of many of their coins, the bird being sacred to their guardian deity, Athené. The species figured is probably the Little Owl (*Carine noctua*), a bird which is common in Greece. It is difficult to guess why the Owl came to be regarded as the embodiment of wisdom, unless it was from its having been sacred to Minerva, the Goddess of Wisdom, who is sometimes represented as the Owl-headed goddess.

"The Owlet's wing," writes Mr. Harting,* "was an ingredient in the cauldron wherein the witches prepared their 'charm of powerful trouble' (*Macbeth*, Act iv., sc. 1); and with the character assigned to it by the ancients, Shakspere, no doubt, felt that the introduction of an Owl in a dreadful scene of a tragedy would help to make the subject come home more forcibly to the people, who had,



LITTLE OWL.

from early times, associated its presence with melancholy, misfortune, and death. Accordingly, we find the unfortunate Owl stigmatised as the 'obscure,' 'ominous,' 'fearful,' and 'fatal' 'bird of night.' Its doleful cry pierces the ear of Lady Macbeth while the murder is being done:—

> 'Hark! Peace!
> It was the Owl that shriek'd, the fatal bellman,
> Which gives the stern'st good-night.'
>
> *Macbeth*, Act ii., Sc. 2.

And when the murderer rushes in immediately afterwards, exclaiming—'I have done the deed. Didst thou not hear a noise?' She replies—'I heard the Owl scream.' And later on—'The *obscure bird* clamour'd the live-long night.'" (*Macbeth*, Act. ii., Sc. 3.)

The awe, no doubt, with which this bird is regarded by the superstitious, may be attributed in some measure to the fact of its flying by night.

> "Deep night, dark night, the silent of the night,
> . . . . . .
> The time when Screech-Owls cry and Ban-Dogs howl."
>
> *Henry VI.*, Part ii., Act i., Sc. 4.

* Ornithology of Shakspere.

And yet, strange to say, the appearance of an Owl by day is by some considered equally ominous :—

"The Owl by day,
If he arise, is mocked and wondered at."
Henry VI., Part iii., Act v., Sc. 4.

"For Night-Owls shriek, where mounting Larks should sing."
Richard II., Act iii., Sc. 3.

Should an Owl appear at a birth, it is said to forebode ill-luck to the infant. King Henry VI., addressing Gloster, says :—

"The Owl shricked at thy birth, an evil sign."
Henry VI., Part iii., Act v., Sc. 6.

While upon any other occasion, its presence was supposed to predict a death, or at least some dire mishap :—

"The Screech Owl, screeching loud,
Puts the wretch that lies in woe
In remembrance of a shroud."
Midsummer Night's Dream, Act v., Sc. 2.

When Richard III. is irritated by the ill-news showered thick upon him, he interrupts the third messenger with

"Out on ye, Owls! Nothing but songs of death?"
Richard III., Act iv., Sc. 4.

The same author, from whom the above Shaksperian illustrations are quoted, alludes further to the superstitious dread of the Owl, which exists likewise amongst the Dyaks of Borneo, and in Ceylon a Wood-Owl, belonging to the same genus *Syrnium*, to which the English Wood-Owl belongs, is known as the "Devil-bird," and is held in great fear. Colonel Irby, writing of the Barn-Owl,* tells the following story from the MS. of the late Mr. Favier, of Tangier :—"The inhabitants of Tangier consider this bird the clairvoyant friend of the Devil. The Jews believe that their cry causes the death of young children; so in order to prevent this, they pour a vessel of water out into the courtyard every time that they hear the cry of one of these Owls passing over their house. The Arabs believe even more than the Jews, for they think that they can cause all kinds of evil to old as well as young; but their mode of action is even more simple than that of their antagonists the Jews, as they rest contented with cursing them whenever they hear their cry. Endeavouring to find out from the Mahometans what foundation there is for the evil reputation of this species, I was told this: 'When these birds cry they are only cursing in their own language; but their malediction is harmless unless they know the name of the individual to whom they wish evil, or unless they have the malignity to point out that person when passing him; as the Devil sleeps but little, when there is evil work to be done he would infallibly execute the command of his favourite if one did not, by cursing the Owl by name, thus guard against the power of that enemy, who is sworn to do evil to all living beings.' Having learned the belief of the Mahometans relative to this Owl, it was more difficult to find out exactly that of the Jews, who, when questioned by me, knew not how to answer, except that the act of pouring water in the middle of the courtyard is a custom of long standing, in order to avert the evil which the Owl is capable of doing; that is to say, the water is poured out with the view of attracting the evil spirit's attention to an object which distracts him, and so hides from him the infant which the Owl in its wickedness wishes to show him."

The late Mr. Waterton, in an entertaining essay on the habits of the Barn-Owl, says :—"Among the numberless verses which might be quoted against the family of the Owl, I think I only know of one little ode which expresses any pity for it :—

'Once I was a Monarch's daughter,
And sat on a lady's knee;
But am now a nightly rover,
Banish'd to the ivy tree.

* "Ornithology of the Strait of Gibraltar," &c., p. 56.

Crying, hoo, hoo, hoo, hoo, hoo, hoo.
Hoo, hoo, hoo, my feet are cold;
Pity me, for here you see me,
Persecuted, poor, and old.'" *

The Owls are divided into two families, the first of which is called *Bubonidæ*, and the second *Strigidæ*. In the latter family are represented only two genera, *Strix* and *Heliodilus*, which contain six species, all the remaining Owls, about one hundred and ninety in number, belonging to the *Bubonidæ*. The breast-bone in the latter family always shows two or more clefts or indentations, and there are no "serrations" on the middle claw, whereas the Barn-Owls always have the inner edge of the middle claw serrated, that is, with a small, toothed margin, like the teeth of a saw (*serra*, Lat., a saw; *serratus*, notched like a saw), and the breast-bone has no clefts in its hinder edge. The *Bubonidæ* embrace two sub-families, the *Buboninæ*, which have no *operculum*, or fold of skin, closing in the ear, and the *Syrniinæ*, which have a very large *operculum*. It seems natural to commence the classification of the Nocturnal Accipitres with the Bare-legged or Fishing Owls, as the structure of this part very much resembles that of the Osprey, which was the concluding representative of the Diurnal Accipitres. The thigh feathers are thick, and fit close to the leg; the tarsus and toes are bare; the outer toe is reversible; and the soles of the feet are covered with tiny spicules, which serve to hold fast their finny prey in the same manner as do those of the Osprey.

THE FISH OWL.

The following account of the Indian Fish Owl (*Ketupa* † *ceylonensis*) is taken from the work by Captain Vincent Legge, R.A., on the birds of Ceylon:—"This large Owl loves the vicinity of water, haunting the banks of rivers, tanks, inland salt lagoons, the borders of sea-bogs, and woods surrounding rice-fields. All who have visited the tanks in the north and east of Ceylon must be familiar with the fine bird, which so often is surprised napping in the lofty trees growing on the embankments, or so-called 'bunds.' Its powers of vision in the day are not quick, but they are tolerably clear. On hearing the footsteps of man, it raises its large ear-tufts, and bending down its head, stares steadily down from its lofty perch among the green boughs, and as soon as it becomes aware of the nature of the intruder on its retreat, launches itself out of the tree, and is not easily approached a second time. It is much more common in wild forest country, combined with water, than in cultivated districts. It sallies out in the evening with great regularity. As soon as the sun begins to sink behind the surrounding forest, it may be noticed flapping noiselessly round some secluded cheena, or leisurely crossing the lonely tank, resounding at the hour of sunset with the buzzing of innumerable frogs, to the nearest conspicuous tree, and there gives out its sepulchral groan. This gloomy salutation is usually responded to by its mate, who perches close at hand, and answers by a double note, the two lonesome sounds resembling the words *gloom—oh, gloom*. At night I have often heard these notes repeated by a pair without intermission for many minutes. Layard remarks that, when alarmed during the day, they utter a loud hiss, subsiding into a growl. They appear to have an accustomed place of roosting, for Mr. Houldsworth notices that they 'perched day after day on the same branch!' This is very often in an exposed situation, and it frequently falls to their lot to be mobbed by a flock of garrulous Bulbuls, King-Crows, and other Owl-hating small birds. Fish is the favourite food, and, in fact, the usual diet of this species; but when this is not procurable, small mammals, reptiles, and even insects are devoured by them. In the stomach of one, for example, I found a Snake (*Haplocercus ceylonensis*), and some large Beetles. As a proof of their miscellaneous diet, and also of their voracity, I may mention that a pair of Fish Owls, which were kept by Sir Charles Layard in the same aviary with a Brahmin Kite, fell one night upon their luckless companion, and, after slaughtering him, forthwith proceeded to devour him completely. Further, Mr. Hume records, in 'Nests and Eggs,' finding the remains of Quails, Doves, and Mynahs in the nest of a pair on the Jumna. It has also been stated that they feed on the carcases of the Gavial and Crocodile."

* "Essays on Natural History," p. 8.

† *Ketupa*, a "barbarous" name, with no meaning.

EAGLE OWL.

PEL'S FISH-OWL (*Scotopelia peli*).*

The African Fish-Owls are exactly like the Indian as regards their bare legs, but they have no tufts on their heads. Three different kinds are known, and they are all rare birds, frequenting the rivers and inland lakes of the African continent. Pel's Fish-Owl was discovered on the Gold Coast by Mr. Pel, the Dutch commandant at Elmina, nearly forty years ago. The specimen procured by that gentleman flew across the river Boutry, and settled among some shady boughs on the other bank, when it was knocked down with the blow of a gun. The following account of one of these rare birds, from the Barra country, Senegambia, is given by Mr. John Henry Gurney, who had the specimen alive in his possession for a long time: it was presented to him by Colonel O'Connor, C.B., who is the author of the accompanying "Sketch of Nero, the Owl, a Fetish Bird." The colonel writes†:—

"During seven years' exploration of Western Africa, I only met one of the species of the Owl 'Nero.' He was brought 'a chicken,' full of pen-feathers, or rather down, of a delicate straw-colour, and very thick, from a lagoon in the Barra country. No native would admit 'Nero' as a visitor; and when the bird was installed in Government House, the servants and head people came in a body to remonstrate, asserting 'he was a Gumbi Owl, a Fetish!! and would destroy and kill whatever object he looked on.' The chief groom (an old soldier, who had charge of the poultry) insisted that 'every cock and hen would go dead.' Strangely enough, an epidemic broke out, and carried off from fifty to sixty head of fowls; and each day the groom placed the defunct birds on the steps of Government House, to meet the eye of Mrs. O'Connor, seeming to exult in the mortality amongst the feathered tribe. 'You see wid your own eye, Missus, dat debil Jumbi bird, he go kill all de fowls. Governor tink he hab long head, but he no sabey Owl. Suppose you put him in de stable, he see Nelly (Mrs. O'Connor's favourite mare), de horse he go tumble down dead.' Death at last ceased to reign amongst the poultry population, and Nero became my principal pet; he ranged over the piazza, perching on the branch of a tree; he was fed regularly by the orderly on roasted fish, but he often came to the dinner-table, and flew down for scraps of meat, bread and butter, which he took gently from myself or from Mrs. O'Connor, permitting us to rub his head, crest, neck, and back, seemingly enjoying the caressing. But he would snatch meat or bones from the Cat or Dog; and when the Eagle was introduced into his company, he beat him in a most unmerciful manner away from his peculiar and original position of the piazza, the Eagle being one of the fiercest and most pugnacious of African birds, brought from the upper part of the Gambia river near 'Wallie,' and, when in vigour, able to carry away a kid or small lamb. Nero luxuriated in a tub of water, frequently washing himself, and perching on the rim until dry. He was wont to go out to the garden or fields, where instantly an immense commotion arose among all the birds. The larger ones flew round the Owl, keeping a very civil distance, the smaller birds flew away; but Nero treated both alike with sovereign contempt. He would return of his own accord to the roosting-place in the piazza, and when put out and confined for some days, rejected all food, and pined until restored to his perch. With me he was as tame as any Canary, and, after an absence of two months, recognised my voice when I went to his cage at Oatlands (Devon), appearing much pleased by my taking him out for a walk on the grass. Many natives from the interior told me 'they had never seen such a bird before; but they considered him *unlucky*.' I really think Nero is nearly *sans* any relations, and certainly devoid of all friends in Western Africa."

Pel's Owl measures nearly two feet in length, and has the wing sixteen inches and a half. Its colour is a deep rufous bay, with black transverse bars; below it is light bay, with heart-shaped bars of black; the iris is dark-brown, whereas in the Indian Fishing Owls it is always yellow.

THE EAGLE OWL (*Bubo ignavus*).‡

This and its relative, the Virginian Eared Owl of America, are the largest of all the family. It is found all over Europe and Siberia, extending even to China and the Himalayas, but the few instances of its capture in Great Britain have been probably those of birds escaped from confinement, as it is by no means an uncommon species in aviaries in England. As it is not, strictly speaking,

* σκότος, darkness; πέλεια, a Dove, with a covert allusion to the name of the discoverer (Sclater). † Ibis, 1859, p. 47.

‡ *Bubo*, a Horned Owl (Vergil); *ignavus*, dastardly—an inappropriate title for so fine a bird.

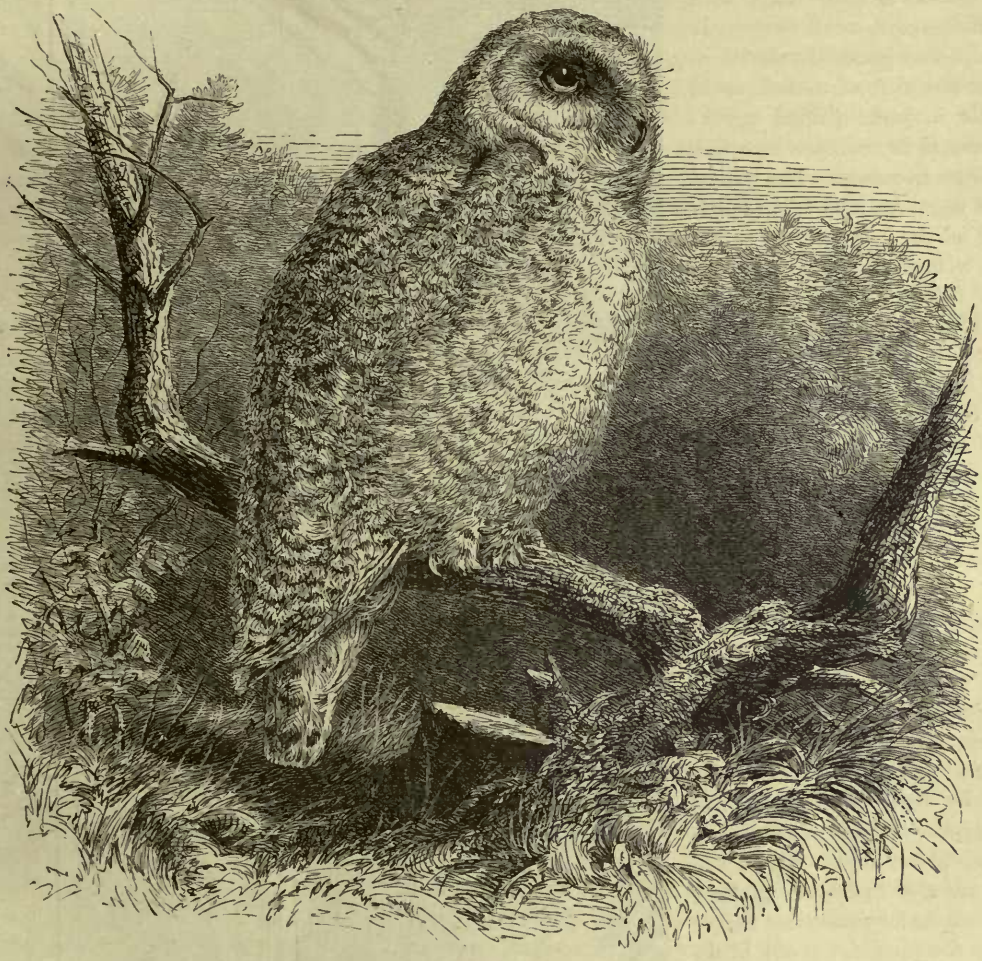
a British bird, recourse must be had to the writings of Continental naturalists for an account of its habits, and the following extract is made from Dr. Brehm's "Bird Life" (p. 567):—"The Eagle Owl is somewhat fantastic in appearance, usually sitting with its feathers so much ruffled as to make it seem much larger than it really is. 'In that large, shapeless mass of feathers,' says Naumann, 'one can scarcely distinguish the limbs; the half-closed eyes hide their glorious rays; suddenly it opens them wide, bends the head and upper part of the body forwards, swaying from side to side, and raising first one foot and then the other, begins to tremble, winks slowly with the eyelids, spits like a cat, and snaps its bill. When angry its eyes flash fire, it bends forward with hanging wings, ruffles its plumage as much as possible, and snapping and hissing, dashes furiously at the enemy.'

"This bird seems less courageous than surly and quarrelsome, and yet it is asserted that it will fight to the death with the Golden Eagle, when attacked by the latter. The Eagle Owl is a powerful bird, and as there are no bounds to its fury, it is but rarely that anything escapes from its grasp. Though strictly nocturnal in its habits, it always keeps a good look out for its own safety in the daytime, and is ever shy and cautious. Keen of sight and hearing, it takes wing while the danger is still far off. Like other Owls, this bird is fond of pressing itself against the stem of a tree, with unruffled feathers, so as to closely imitate the stump of a tree, and thus escape detection. Inasmuch as deep clefts in the rocks, or the thickest of trees, are its usual retreats, the Owl is often passed over, which fact is undoubtedly an advantage, for the day birds mob it whenever they see it. They may possibly have made it the savage, spiteful bird it is, inasmuch as their system of constant irritation would be sufficient to try the temper of the mildest individual. Thus nothing remains for the Owl but to evade its disturbers, and hide itself as long as possible; but woe betide it if discovered, for then the friends of daylight treat it to a 'charivari' without equal.

"The first to arrive on the scene is the ubiquitous Crow, conducted thither by some inquisitive warbler who has discovered the enemy's retreat. The Crow thoroughly understands what the little fellow means, and hastens to convince itself of the truth of the information. Having satisfied itself, it retires noiselessly, but only to carry the news to its relatives. Now they flock in from all sides to take part in the fight, with an eagerness worthy of the boldest man; greeting one another with hoarse and scornful croaks, the sooty tribe hasten as fast as they can to the scene of action. The mockers surround the poor old 'Grand Duke,' at first at a respectful distance, though they are fully determined effectively to disturb its siesta. There sits the Owl, rolling its eyes, spitting, snapping its beak, and ruffling its feathers, now hopping from one leg to another, now raising and lowering its feathered horns by turns; mad with rage, bemoaning its fate, and at loggerheads with the whole world, it awaits the turn that matters may take; at the same time, be it remembered, every Crow takes good care not to lay hold of the irritated gentleman; nothing less than a Raven dares to rely on its own strength. One of these, however, will run a tilt at the dark knight, using its sharp beak as a lance; but before the latter has time to raise the terrible claw, the Raven makes good its retreat, prepares for another rush, and darts like an arrow, so as to use its weapon effectively. The Owl now loses the last remnant of patience, and seeks safety in flight. Oh, unlucky wight! this is all the black swarm have been waiting for, the Crows being far its superiors on the wing. Giving vent to exulting cries, they dart down from above with such unerring aim and force as to scatter the poor brute's feathers in clouds to the wind: they rise again with a mighty noise that heeds no secrecy, as though they sought to proclaim to the world at large all the fell deeds committed by this Prince of Darkness, while other knights advance to battle. All Hawks and Falcons, ay, the proud Eagle even, answer to the call, and hasten to take part in the fray. Now the Owl must, perforce, either beat a hasty retreat or remain on the field. In any case, however, the Owl is thoroughly worried, and sometimes really damaged, before it finds refuge in some thick tree or rocky cleft, where it hides itself as closely and as silently as its rage will permit, until quit of the Crows.

"The detestation in which the Eagle Owl is held by all diurnal birds is not ill-founded, for this bird preys on every living creature it can overcome, assassinating them in the most abominable manner while they are asleep. Its quarry is as follows:—Fawns of the Roe Deer, Hares, Rabbits, Hamsters, Rats, Moles, Mice, Capercailzie, Black-game, Hazel-hens, Pheasants, Partridges, Rooks, Jays, Magpies, Snakes, Lizards, and Frogs; Rooks seem to be its favourite morsel. No wonder, then, that they pay their enemy out if they can only see an opportunity. It assassinates them; they

attack it in open day. The Eagle Owl generally breaks the spine of the smaller animals close to the head, and, cracking the remaining bones, devours its prey, skin and all; the heads of the larger birds it pulls in large pieces which it swallows. It, however, always devours a portion of the hair, feathers, or scales as well, and wastes away if fed on flesh alone. The indigestible portions of the meal are thrown up in large round pellets or 'casts.' With larger animals, it lays open the skin of the belly, and eats out the flesh from inside. If it finds that there is too much for one meal, it carefully replaces the skin, and hides the remainder in some dark cranny or corner until required again. This Owl



SNOWY OWL.

drinks rarely, slaking its thirst generally with the blood of its victims. If food is plentiful, it gorges itself; but in times of dearth it can go without food for weeks together.

"By the last fortnight in March the Eagle Owls commence preparations for breeding. At this season may be heard their hollow, muffled cry of 'poohoo, poohoo,' which is distinguishable at a great distance through the woods, and it is not to be wondered that the timid are frightened at it. In the silent, dark recesses of the mountain forest a variety of noises, well calculated to make one's flesh creep, fall upon the ear: the shrill, mocking laugh, a sound as of snarling hounds; the whoop of the hunter, the snorting of Horses; these are all calculated to impress the uneducated and superstitious with the truth of the legend of the wild huntsman. Even to the ear of the better-informed, these hideous cries, the loud screech of the female, or the 'poohoo' of the male, intermingled with the snapping of the beak and curious miaulings, sound somewhat weird; and the boldest of mortals can

scarcely repress a cold shudder when a company of these forest spirits favour him with one of their demoniacal nocturnal concerts. Doubtless these sounds represent the battle-cries of the males when fighting for the females, and take the place of the song of the Nightingale when telling its tale of love.

"After the Owls have paired these cries are heard less frequently, both birds being now fully occupied with their nursery operations. The large nest is composed outwardly of branches and sticks, and is lined with dry leaves and small twigs. It is built, and generally placed in either the cleft of a rock or in a hole in some ruined tower; the nest is never built in a tree but from necessity. The two or three eggs are also often found lying on the bare surface of the rock, without any nest whatever. They are round, cross-grained, and white, and somewhat larger than a hen's egg. The young are hatched in about three weeks. They are usually two in number, rarely three; they look, on their first appearance, like balls of cotton-wool, and keep up a constant hissing or shrill whistle. They remain a long time in the nest, and are so abundantly provided with food by the parent birds, that one is sure to find a large heap of provisions at the nest. The Owlets often betray their presence to their innumerable enemies by their cries, and suffer much persecution in consequence. When about eight weeks old they are able to fly, though they still remain for some time longer under the care of the old birds. These latter rarely wander far from a particular neighbourhood, and usually build in the very same place the following year."

SHORT-EARED OWL.

Besides the Eagle Owls, the sub-family *Buboninæ* contains the Snowy Owl (*Nyctea* scandiaca*†), all the Hawk Owls (*Surnia*‡ *Ninox*§), and the Pigmy Owlets (*Glaucidium*‖). Many of the birds belonging to this latter genus are not much bigger than a Sparrow. They are found nearly all over the world, with the exception of Australia and Oceania, and one species, the European Pigmy Owlet

* νύκτιος, nightly, *i.e.*, a bird of night—a most inappropriate title for the Snowy Owl, which is a day-flier.
† *Scandiaca*, Scandinavian. ‡ A proper name. § A "barbarous" name, of no meaning.
‖ From γλαυκός, blue or grey.

(*G. passerinum**), is by no means uncommon in many parts of the Continent, though it has not yet been met with for certain in the British Islands.

The sub-family *Syrniinæ* contains only three genera, the Horned Owls (*Asio*†), the Wood Owls (*Syrnium*‡), and the Tengmalm's Owl (*Nyctala*§ *tengmalmi*), the latter having been already noticed (p. 297) as possessing the curious difference in the ear-opening on each side of the skull. Of the Horned Owls two species are found in the British Islands, viz., the Short-eared Owl (*Asio accipitrinus*‖), and the Long-eared Owl (*A. otus*¶). The former of these birds is often seen in the daytime, and is said to hunt for its prey on dull days, when it will fly at small birds as well as mice; and Mr. Low, writing on the birds of the Orkneys, where the Short-eared Owl breeds, says that he has found in the nest the remains of a Moor-fowl (Red Grouse), two Plovers, besides the feet of several others; and the same writer states that during the breeding season it becomes very impudent, and will even seize and catch up chickens from the doors, and also chase pigeons in open daylight. Although resident in the British Islands, a large migration of the species takes place in autumn, and it is not unfrequently shot by sportsmen in the turnip-fields; while Bewick mentions the recurrence of twenty-eight individuals being flushed in a turnip-field in November, being probably attracted to the locality by an abundance of food. It may also be occasionally found in marshes near the sea-shore, as occurred once to the writer, who started a Short-eared Owl from the sedgy bank on the west side of Pagham Harbour, in the early part of September. When winged, it boldly faced its pursuer, erecting the little tufts on its head and fiercely snapping its bill, as is the manner with all Owls in defending themselves.

FACE OF THE BARN OWL.

Its relation, the Long-eared Owl, is a bird of different habits, and, instead of breeding on the ground as the foregoing species does, it selects a dark wood or clump of firs, appropriating a deserted Squirrel's "dray," or adapting the nest of another bird to its own requirements. Macgillivray gives the following account of a young specimen which he had in confinement:—"An individual of this species, which was sent to me in winter by the Rev. Mr. Adam, having been left at night perched on the back of a chair in my drawing-room, tore to tatters six valuable skins of birds from the Rocky Mountains, and an equal number of nearly equally rare specimens from India. A young bird which I kept for some time, on perching, stood at first with the body inclined, afterwards nearly erect, and slept in the latter posture, with its neck rather extended, its feathers drawn close, and its tufts recumbent. When irritated, it raised its plumage, threw its body forward, and uttered a sharp cry. It seized its food with its bill; if large, transferred it to one of its feet, but if otherwise, retained it in its bill. In flying, it carried a small object in its bill, but a larger in its foot. It could close one eye while the other remained open, and when placed in a strong light, frequently drew the membrane over the lighted eye, while the other remained unsheathed, though for the most part it winked with both simultaneously. The irides contracted unequally, according to the degree of light. When perched at night, it sometimes emitted a clicking noise, like that of a spring, with its bill; but when provoked, it neither hissed nor snapped, but uttered a shrill, tremulous, plaintive cry, or succession of short notes, erecting its tufts at the same time."

THE BARN OWL (*Strix* ** *flammea* ††).

This is essentially the friend of man, frequenting villages and homesteads where he is protected, and extending his range where civilisation precedes him, being attracted doubtless by the Mice and Rats, which are also the accompaniments of civilisation. The number of small mammals which one of these birds will devour ought to be his passport to the protecting care of the farmer and agriculturist,

* Passerine, or Sparrow-like: *i.e.*, of the size of a Sparrow. † A proper name. ‡ Σύρνιον, a proper name.
§ νυκταλός, nocturnal. ‖ Like a Hawk. ¶ ὦτος, long-eared Owl. ** στρίγξ, an Owl.
†† Fiery; flame-coloured.

but it is seldom that an Owl of any kind meets with approval on taking up his residence on an estate. Facts, however, are stubborn things, and in the hope that a more generous reception may be afforded to these useful birds, the following quotation is made from Professor Newton :—"Owls, like other birds of prey, as already mentioned, return by the mouth the indigestible parts of the food swallowed in the form of elongated pellets. These are found in considerable numbers about the usual haunts of the birds, and examination of them reveals the nature of the food, and shows in nearly every case the great services they render to man by the destruction of Rats and Mice."* The infallibility of the evidence thus afforded as to the food of the Owls is as complete as the way of obtaining it, by those who have the opportunity, is simple. Several German naturalists have made some very precise researches on this subject. The following results, with regard to the three commonest species of Owls, are those afforded by the investigations of Dr. Altam, as communicated by him to the German Ornithologists' Society during its meeting in 1862 :—

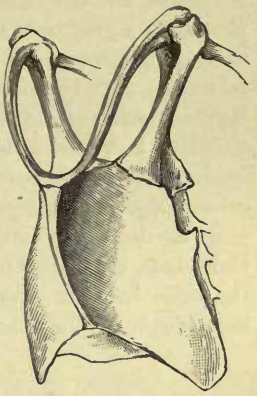
	Remains Found.								
	No. of Pellets examined.	Bats.	Rats.	Mice.	Voles.	Shrews.	Moles.	Birds.	Beetles.
Tawny Owl . .	210	—	6	42	296	33	48	18	48
Long-eared Owl . .	25	—	—	6	35	—	—	2	—
Barn Owl . . .	706	16	3	237	693	1,590	—	22	—

Colonel Irby, in the work which has already been alluded to, says of the Barn Owl :—"Almost exclusively feeding on Rats and Mice, they deserve every encouragement and support that can be afforded them; but from being in all countries regarded with superstitious awe and dislike, they are more or less persecuted on that account; and in England, through the ignorance and stupidity of gamekeepers, who fancy that they kill game (*i.e.*, feathered game), they suffer most severely. This excuse is ridiculous, for old birds they have not the power to kill, and young Pheasants and Partridges, at the time the Owls are on the feed, are safely being brooded by the parent bird." Those who wish to encourage and increase Owls, and have not hollow trees or buildings where they nest, may always gratify their wishes by fixing an empty barrel (about an 18-gallon size) horizontally in the fork of any large tree, cutting a hole in one end large enough for the birds to enter; but the hoops of the cask should be screwed on, or it will soon fall to pieces. Not only the Barn Owl, but the Tawny Owl (*Syrnium aluco*) also will use barrels, or "Owl-tubs." The difficulty, however, is to keep out the Jackdaws, but when once the Owls have established themselves, there is no fear of that intrusion. The late Mr. Waterton was a well-known admirer of the present species, and he devotes one of his "Essays on Natural History" to the Barn Owl, from which a few passages are extracted :—"Up to the year 1813 the Barn Owl had a sad time of it at Walton Hall. Its supposed mournful notes alarmed the aged housekeeper. She knew full well what sorrow it had brought into other houses when she was a young woman, and there was enough of mischief in the midnight wintry blast, without having it increased by the dismal screams of something which people knew very little about, and which everybody said was far too busy in the churchyard at night-time. Nay, it was a well-known fact, that if any person were sick in the neighbourhood it would be for ever looking in at the window, and holding a conversation outside with somebody, they did not know whom. The gamekeeper agreed with her in everything she said on this important subject, and he always stood better in her books when he had managed to shoot a bird of this bad and mischievous family. However, in 1813, on my return from the wilds of Guiana, having suffered myself, and learned mercy, I broke in pieces the code of penal laws which the knavery of the gamekeeper and the lamentable ignorance of the other servants had hitherto put in force, far too successfully, to thin the numbers of this poor, harmless, unsuspecting tribe. On the ruin of the old gateway, against which tradition says the waves of the lake have dashed for the greater part of a

* Newton's edition of Yarrell's "British Birds," Vol. I., p. 147.

thousand years, I made a place with stone and mortar, about four feet square, and fixed a thick oaken stick firmly into it. Huge masses of ivy now quite cover it. In about a month or so after it was finished a pair of Barn Owls came and took up their abode in it. I threatened to strangle the keeper if ever, after this, he molested either the old birds or their young ones; and I assured the housekeeper that I would take upon myself the whole responsibility of all the sickness, woe, and sorrow that the new tenants might bring to the Hall. She made a low courtesy, as much as to say, 'Sir, I fall into your will and pleasure,' but I saw in her eye that she had made up her mind to have to do with things of fearful and portentous shape, and to hear many a midnight wailing in the neighbouring woods. I do not think that up to the day of this old lady's death, which took place in her eighty-fourth year, she ever looked with pleasure or contentment on the Barn Owl, as it flew round the large sycamore trees which grow near the ruined gateway.

"When I found that this first settlement on the gateway had succeeded so well, I set about forming other establishments. This year I have had four broods, and I trust that next season I can calculate on having nine. This will be a pretty increase, and it will help to supply the place of those which in this neighbourhood are still unfortunately doomed to death by the hand of cruelty or superstition. We can now always have a peep at the Owls in their habitation on the old ruined gateway whenever we choose. Confident of protection, these pretty birds betray no fear when the stranger mounts up to their place of abode. I would here venture a surmise that the Barn Owl sleeps standing. Whenever we go to look at it we invariably see it upon the perch, bolt upright, and often with its eyes closed, apparently fast asleep. Buffon and Bewick err, no doubt unintentionally, when they say that the Barn Owl snores during its repose. What they took for snoring was the cry of the young birds for food. I had fully satisfied myself on this score some years ago. However, in December, 1823, I was much astonished to hear this same snoring kind of noise, which had been so common in the month of July. On ascending the ruin, I found a brood of young Owls in the apartment.



BREAST-BONE OF THE BARN OWL.

"Upon this ruin is placed a perch, about a foot from the hole at which the Owls enter. Sometimes, at mid-day, when the weather is gloomy, you may see an Owl upon it, apparently enjoying the refreshing diurnal breeze. This year (1831) a pair of Barn Owls hatched their young, on the 7th of September, in a sycamore tree, near the old ruined gateway.

"If this useful bird caught its food by day, instead of hunting for it by night, mankind would have ocular demonstration of its utility in thinning the country of Mice; and it would be protected and encouraged everywhere. It would be with us what the Ibis was to the Egyptians. When it has young, it will bring a Mouse to the nest about every twelve or fifteen minutes. But in order to have a proper idea of the enormous quantity of Mice which this bird destroys, we must examine the pellets which it ejects from its stomach in the place of its retreat. Every pellet contains from four to seven skeletons of Mice. In sixteen months from the time that the apartment of the Owl on the old gateway was cleaned out, there has been a deposit of above a bushel of pellets. The Barn Owl sometimes carries off Rats. One evening I was sitting under a shed, and killed a very large Rat as it was coming out of a hole about ten yards from where I was watching it. I did not go to take it up, hoping to get another shot. As it lay there, a Barn Owl pounced upon it, and flew away with it. This bird has been known to catch fish. Some years ago, on a fine evening in the month of July, long before it was dark, as I was standing on the middle of the bridge, and minuting the Owl by my watch as she brought Mice into her nest, all on a sudden she dropped perpendicularly into the water. Thinking she had fallen down in epilepsy, my first thoughts were to go and fetch the boat; but before I had well got to the end of the bridge, I saw the Owl rise out of the water with a fish in her claws, and take it to the nest. When farmers complain that the Barn Owl destroys the eggs of their Pigeons, they lay the saddle on the wrong horse; they ought to put it on the Rat. Formerly, I could get very few young Pigeons, till the Rats were excluded effectually from the dovecot. Since that took place it has produced a great abundance every year, though the Barn Owls frequent it, and are

encouraged all around it. The Barn Owl merely resorts to it for the purpose of concealment. If it were really an enemy to the dovecot, we should see the Pigeons in commotion as soon as it begins its evening flight; but the Pigeons heed it not. Whereas, if the Sparrow-Hawk or Hobby should make its appearance, the whole community would be up at once; proof sufficient that the Barn Owl is not looked upon as a bad, or even a suspicious character, by the inhabitants of the dovecot."

The colour of the Barn Owl, which is a bright orange buff, mottled with ashy-grey on the upper surface, and white below, distinguishes it from any other Owl. The oval form of the disc is also to a great extent peculiar, as is also the serrated edge to the middle claw, which has been referred to before (p. 300). The breast bone is likewise remarkable, as it has no clefts in the hinder margin.

The range of the present species is very considerable, as it is found all over the New World, from the northern and middle United States down to Patagonia and the Falkland Islands. In the Old World it occurs in equal plenty, but does not extend very high north, being a rare visitant to Denmark and Sweden. Although common in Poland, it is only sparingly distributed throughout Russia, and even appears to be entirely absent in many Central and Southern parts. The same may be said of Turkey. It is not known at present from Siberia or China, but is found throughout Africa, India, Australia, and the majority of the Oceanic Islands. Nearly all Owls have two distinct phases of plumage—a grey one, and a red one. This is especially the case in the little Scops Owls, which have tufts of feathers on the head like the Eagle Owls, of which they may be said to be representations in miniature. The Barn Owls are no exception to this general rule of the family; but owing to the light colouring of the bird, it is not so perceptible as in some of the other species of Owls. Even in England, however, a short study of the species will show the student that some individuals are much redder underneath, instead of being white, and are profusely freckled with grey above; and this dark coloration does not depend upon the age of the bird, nor is it a difference of sex. In some islands, such as the Cape Verde group, San Domingo in the West Indies, the Falkland Islands, and the Galapagos, the Barn Owls are almost always dark-coloured, and light ones are very seldom found. On the other hand, in Australia and Oceania the species becomes peculiarly light in plumage, and dark individuals are the exception.

THE SECOND ORDER.—PICARIAN BIRDS (*Picariæ*).*

CHAPTER VII.

THE PARROTS.

Characteristics of the Order—The Sub-orders—ZYGODACTYLÆ—The Parrots—Their Talking Powers—Sections of the Family—The Great Palm Cockatoo—The Pygmy Parrots—The Amazon Parrots—The Amazons—The Grey Parrot—Court Favourites—Historical Specimens—In a State of Nature—Mr. Keulemans' Observations—The Conures—The Rose-ringed Parrakeet—Known to the Ancients—Habitat—Habits—The Carolina Conure—Destructive Propensities—The Parrakeets—The Owl Parrot—Chiefly Nocturnal—Incapable of Flight—How this Fact may be accounted for—Dr. Haast's Account of its Habits—The Straight-billed Parrots—The Brush-tongued Parrots—The Nestors—The Kaka Parrot—Skull of a Parrot—The Bill.

The birds which are contained in this order are of very different forms, but they possess one character which, although an osteological one, is found throughout nearly the whole group, and that is, the double notch in the hinder margin of the sternum or breast bone. In all the true *Passeres*, or perching birds, only a single notch is observed. The hind toe, which in the true perching birds is an essential character, and is separately movable, possessing its own distinct flexor muscle, is in the Picarians not of so much account, its flexor muscle being joined to the common flexor of all the toes; it is sometimes absent altogether. If the Parrots have certain characters in common with the *Accipitres*, the Cuckoos and the Plantain-eaters undoubtedly show affinity to the Game-birds, while most of the other families have peculiar structures which render them quite distinct from the ordinary mass of true perching birds or Passeres. It may be remarked that the eggs of most of the *Picariæ*, so far as we are acquainted with them, are glossy white, and that the majority of them breed in the holes of trees or of

* From *Picus*, a Woodpecker.

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COCKATOOS.

rocks, and that they are as a rule bad nest-builders. The greatest exception to the above description of the nesting of these birds is met with in the family of Goatsuckers (*Caprimulgidæ*), some of whom lay their eggs on the ground, the eggs being beautifully marbled with streaks and spots.

Within this great Picarian order there are two large sub-orders, called respectively the Scansorial and the Fissirostral* *Picariæ*. The Scansorial birds are also sometimes known as the Zygodactylæ,† or yoke-footed birds, because they have their toes arranged in pairs, two in front and two behind, and their name of Scansores is given to them because most of them are climbing birds, and run up trees and rocks with great facility, though in different ways. Parrots, for instance, use their bills in climbing from branch to branch, while Woodpeckers have very powerful feet and stiffened tail-feathers, which support them as they cling to the bark of the trees, the bill being chiefly employed to prise off the bark in order to get at the insects underneath. Cuckoos do not climb trees in the same manner as the Woodpeckers, though they have true zygodactyle feet: the present writer has, however, seen a common Cuckoo (*Cuculus canorus*) cling with both feet to the trunk of a huge elm while it picked off insects from the bark. It must not be supposed, however, that the above are the only birds which climb trees, for among the true Passeres, or perching birds, there occur such birds as the *Dendrocolaptidæ* in South America, who have stiffened tails exactly as the Woodpeckers, while the Tree-creepers are just as expert as the last-named birds, and yet cannot be placed in the same order as the Scansorial (*Picariæ*), for they possess a simple passerine foot, with three toes in front and one behind.

The Fissirostres, or wide-gaping birds, are also called Gressorial Picariæ, as their toes are more or less connected together, which gives them a very flat sole to the foot. They generally hunt for their food from some selected spot, ordinarily a post or a dead bough, whence they take flights after their prey, usually returning to the same spot to devour it. Their flight is active and swift, their gape extremely large, and the head correspondingly big, and in many instances clumsy and ungainly. The feet are generally small and weak.

SUB-ORDER I.—ZYGODACTYLÆ.

FAMILY I.—THE PARROTS (*Psittaci*).

Just as the Monkeys have been placed at the head of the Mammalia on account of their high development, so the Parrots, from their general cleverness, and especially on account of the facility with which they can talk, have been considered the highest order of birds, and placed at the beginning of the class. It is impossible for some people to avoid the conclusion that these birds think and reason, and the *à propos* or sometimes *mal à propos* way in which they introduce speeches, coupled with the look of wisdom which they assume while being spoken to, seems to show that the brain is being employed in thinking. A friend in Manchester told the writer of a parrot-show in the North of England, where the talking powers of each bird were made the subject of a prize competition. Several of the birds had exhibited their prowess, and at last the cover was removed from the cage of a Grey Parrot, who at once exclaimed, on seeing the company to which he was suddenly introduced, "By Jove! what a lot of Parrots!" an observation which gained him the prize at once. Instances of famous talking birds might be multiplied by the hundred, and it is wonderful to read some of the stories which have been related of Parrots, whose fame has been recorded in many popular works, leaving no doubt that these birds often possess the power of reason of a very high order; at the same time, it must be confessed that many of the Corvine birds, such as Ravens, Jackdaws, and Magpies, do not fall far short of their Scansorial friends.

The Parrots are divided into two large sections, firstly the Parrots proper (*Psittaci proprii*), and secondly the straight-billed Parrots (*Psittaci orthognathi*‡). These two sections together contain six families, of which five belong to the first and one to the second. The true Parrots have a powerful and swollen bill, especially as regards the lower mandible, which is much inflated, curved, and flattened in front, the cutting edges (*tomium*) indented just behind their tip. The sub-family which has to be noticed first are the *Camptolophinæ*§ or Cockatoos, which are birds entirely of the Australian

* *Fissus*, cleft; *rostrum*, a beak. † ζυγόν, a yoke; δάκτυλος, a toe. ‡ ὀρθός, straight; γνάθος, a jaw.
§ κάμπτω, to bend; λόφος, a crest.

region, being confined to Australia and the Molucca Islands. The bill is higher than it is broad, with a very distinct indentation of each side of the cutting edge of the mandible, the tip of the bill short, rather strong and perpendicular, the head crested in all except the Pygmy Parrots (*Nasiterna*). This family contains at once the largest and the smallest of the Parrots.

THE GREAT PALM COCKATOO (*Microglossus* aterrimus*†).

This is one of the most powerful of all the Parrot tribe, measuring about twenty-four inches in length, and having a bill of unusual thickness and power. Its black plumage also renders it a conspicuous species, the only relief to this sombre colouring being the greyish crest and the dull crimson cheeks. Its home is New Guinea, but it is also found in the Cape York Peninsula in Australia, where it was discovered by John Macgillivray during the voyage of the *Rattlesnake*. He writes as follows respecting it :—"This very fine bird, which is not uncommon in the vicinity of Cape York, was usually found in the densest scrub among the tops of the tallest trees, but was occasionally seen in the open forest land perched on the largest of the *Eucalypti*, apparently resting on its passage from one belt of trees or patch of scrub to another. Like the Black Cockatoos, or *Calyptorhynchi*, it flies slowly and usually but a short distance. In November, 1849, the period of our last visit to Cape York, it was always found in pairs, very shy, and difficult of approach. Its cry is merely a low short whistle of a single note, which may be represented by the letters '*Hweet-Hweet*.' The stomach of the first one killed contained a few small pieces of quartz and triturated fragments of palm-cabbage, with which the crop of another specimen was completely filled; and the idea immediately suggests itself, that the powerful bill of this bird is a most fitting instrument for stripping off the leaves near the summits of the *Seaforthia elegans* and other palms to enable it to arrive at the central tender shoot."

THE PYGMY PARROTS (*Nasiternæ*).

These Parrots are represented by seven little manikins which are found in New Guinea and the adjacent islands, each particular island possessing its own peculiar species. Not one of these little birds exceeds a Sparrow in size, the largest being a little over three inches and a half in length. Owing to their small size and the resemblance of the green colouring to the forests they inhabit, they are not easily seen, and until recent years were very hard to procure. In the island of Mafoor in the Bay of Geelvink, N.W., New Guinea, Baron von Rosenberg says that he found it common near Roemsaro, and several specimens, both alive and dead, were brought to him by the natives. They bred there in January and February, nesting in hollow trees and laying two eggs, the size of those of the English Bottle Titmouse. Their food consists of fruit.

THE AMAZON PARROTS (*Androglossinæ*).‡

This, the second sub-family, consists of the true Parrots, of which the ordinary Grey Parrot (*Psittacus erythacus*) is the type. It also includes all the Green Parrots of America, which are called Amazons, as well as the Lories (*Eclectus*) and Love-birds (*Agapornis*). The head is moderately smooth, without any highly-developed crest, as in the Cockatoos, and the tail is short, or of only moderate length. The tail-feathers are generally broad and obtuse, in a few widening at the tip, or sharp at the end. In the genus *Prioniturus*, which inhabits the Philippine Islands, and some of the Moluccas, the two centre feathers have the shafts produced, and ending in a small spatule, or racket.

THE AMAZONS (*Chrysotis*).§

These Parrots are entirely American, and are the only birds of the New World which can compete in talking powers with the African Grey Parrots, who, however, far surpass their American relatives. About thirty species of Amazon are known, all of them confined within the limits of the Neotropical region, which comprises the whole of Central and Southern America, south of an imaginary line drawn through Northern Mexico. The West India islands are also included in this area, and most of them

* μικρός, small; γλῶσσα, a tongue. † Very black. ‡ ἀνήρ, a man; γλῶσσα, a tongue. § χρυσός, gold; οὖς, an ear.

are inhabited by a species of Amazon. The habits of all these Parrots seem to be very similar, and a good account of the Active Amazon of Jamaica (*Chrysotis agilis*) is given by Mr. Gosse* :—"All the Parrots are gregarious, cunning, watchful, noisy, mischievous; and thus are like the Monkeys. This and the Yellow-billed Parrot [Mr. Gosse's name for *C. agilis* is the Black-billed Parrot] are so much alike in manners and general appearance, that a description of one applies nearly to the other. Flocks varying from half a dozen to twenty or thirty fly hither and thither over the forest, screeching as they go, and all alight together on some tree covered with berries. Here they feast, but with caution. On a slight alarm one screams, and the whole flock is on the wing, vociferous if not musical, and brilliant if not beautiful, particularly when the sun shines on their green backs and crimsoned wings. They generally prefer lofty trees, except when, in June, the ripe yellow plantain tempts them to descend, or when the blackberry shines upon the pimento. Of the latter the flocks devour an immense quantity, and the former they destroy by cutting it to pieces with their powerful beaks, to get at the small seeds. One day in January, when the pimento on the brow of Bluefields Mountain was about ready for picking, being full-sized, but yet green and hard, I observed large flocks of Black-bills, and a few Parrakeets, flying to and fro with voluble chatter, now alighting to feed on the hot, aromatic berry, now flying off, and wheeling round to the same neighbourhood again. They were not at all shy, but, with unusual carelessness of one's proximity, scarcely moved at the report of the gun which brought their companions to the ground. Of two which I shot on this occasion, I found the craws stuffed with the cotyledons of the seed alone, the most pungently aromatic part of the berry; the fleshy part having been, as I presume, shorn off by the beak and rejected. When alighted, as is often the case, on a dry branch, their emerald hue is conspicuous, and affords a fair mark for the gunner; but in a tree of full foliage, their colour proves an excellent concealment. They seem aware of this, and their sagacity prompts them to rely on it for security. Often we hear their voices proceeding from a certain tree, or else have marked the descent of a flock upon it, but on proceeding to the spot, though the eye has not wandered from it, and we are therefore sure that they are there, we cannot discover an individual.

AMAZON PARROT.

* "Birds of Jamaica," p. 266.

We go close to the tree, but all is silent, and still as death; we institute a careful survey of every part with the eye, to detect the slightest motion, or the form of a bird among the leaves, but in vain; we begin to think that they have stolen off unperceived, but on throwing a stone into the tree, a dozen throats burst forth into cry, and as many green birds rush forth upon the wing. The screaming of this and the following species differs from that of the Parrakeet, so far as to be easily distinguished. That of the latter consists of a series of harsh screeches, of comparative length; that of the Parrots is less shrill, more broken into short and rapid articulations, forming a series of varying length, separated by momentary pauses. It is, in fact, much more like a hurried chattering."

THE GREY PARROT (*Psittacus erythacus*).

This familiar cage-bird is a native of Africa, and it would appear to have been a favourite in England for a longer period than can be traced. They were held in great estimation at the court of the "Merry Monarch" Charles II., for his Queen Catharine of Braganza had a parrot-keeper, at a salary of £36 per annum, while the maids of honour received only £10 a year each, and the "mother of the maids" £20 per annum. Therefore, the custodian of the Parrots was better paid by £16 than the lady who held the very responsible post of care-taker of the maids of honour.* A Grey Parrot which lived for forty years with the Duchess of Richmond and Lennox, who died in 1702, and who was a celebrated beauty at the court of Charles II., is preserved in Westminster Abbey along with the effigy of that lady, having survived its mistress only a few days.

It is strange that for a bird which has so long been one of the chief pets in Europe, so little is known of its habits in a wild state, and at the present time not a single authentic egg of this species, taken in its native haunts, is known to exist. Occasionally it lays in confinement a white egg, like other Picarian birds, but it is probably from the care with which the species selects its breeding-place that it has been so difficult to find their nest and eggs. The only naturalist who appears to have discovered the latter appears to be the celebrated natural history artist, Mr. Keulemans, who spent nearly two years in West Africa, and has written the best account of the Grey Parrot in a state of nature,† as observed by him on Ilha do Principe, or Prince's Island, in the Bight of Biafra. Here it is very common, and breeds in the month of December in the very thickest forests. Only one pair breed in each tree, laying five eggs in a hole thereof, but a large number nest in close proximity to each other, many hundreds breeding in the same area, according to the above-named author. Both parents take a share in the rearing of the young birds, sitting by turns, the one who is thus relieved bringing food to its mate and feeding it out of its crop, which method is also adopted in the care of the young birds. The food of the Grey Parrot is stated to consist of palm-nuts, the arocat (*Laurus persea*), the banana (*Musa paradisea*), goyare, mango, and many other fruits of a smaller size; but it always gives the preference to palm-nuts. On Prince's Island, writes Mr. Keulemans, there is "a very lofty mountain, reaching some 1,200 feet above the level of the sea, and called by the natives 'Pico de Papagaio,' or Peak of the Parrots. On the slope of this mountain, and extending far up its side, is a magnificent forest. The trees are of great size and height, and their trunks and branches give support to the lianas and other climbing plants, which hang about them in luxurious folds. The density of the forest is so great that it is only with the greatest difficulty and toil that the explorer can force his way through it; while to the Parrots who come up there every night it presents no obstacle, but gives them, under the shelter of its thick foliage, a secure and pleasant resting-place."

Another observer in West Africa, Dr. Reichenow, found the Grey Parrot breeding in West Africa in the low-lands along the streams and groves of mangrove, and the great difficulty of traversing these swamps is, according to him, the reason why their breeding habits are not better known. They are very destructive to the crops of Indian corn, which they visit in large flocks, wasting as much as they consume. They proceed to roost in flocks, selecting the same route each night; and Governor Ussher says that, whilst up the river Addo, near Lagos, he has seen them crossing at sunset from their feeding-grounds to their roosting-places, when they presented the appearance of one continuous flock passing at a great distance overhead, their screams and chattering being heard long after darkness has

* G. D. Rowley, "Ornithological Miscellany," Vol. I, p. 175. † "Natural History of Cage-birds," Part I.

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GREAT MACAWS.

set in. They are said by some travellers to be very good eating, but by others to be only good for soup.

The Grey Parrot in his native haunts is an unsociable bird, and a curious story is told by Dr. Dohrn, and confirmed by Mr. Keulemans, respecting the species in Prince's Island. As has already been stated, the Parrots are extremely common there, but not a single Kite is met with on the island. On the neighbouring island of St. Thomas there is an abundance of Black Kites but not a single Parrot, between whom and the Kites a constant warfare is waged, so that, should one of the latter get driven over to Prince's Island he is almost immediately set upon by the Parrots and slaughtered; and the compliment is returned if a Parrot is so unfortunate as to land uninvited on St. Thomas's. On the coast the chief enemy of the Parrots is the Vulturine Sea-Eagle (*Gypohierax angolensis*).

GREY PARROT.

The colouring of the Grey Parrot is simple, being of a clear bluish-grey, with a red tail. About the face the skin is white, and covered with a soft, velvety feathering, amongst which there is a plentiful supply of white powder, as any one knows who scratches the head of "Polly." This powder is present in most of the family, but not to the same degree as in the grey species. The young bird in the nest is stated to have the tail dark-grey instead of red, and it is more of a brownish-grey colour, not so clear as in the old bird, while the iris is grey instead of yellow.

The CONURES (*Conurinæ*) are the third sub-family of Parrots, and are represented largely in America, only one genus, *Palæornis*, being found in India and Africa. They have the head devoid of a crest, with a very long graduated tail, and short and weak tarsi. Amongst the best-known species of this sub-family may be mentioned the Great Macaw.

THE ROSE-RINGED PARRAKEET (*Palæornis torquatus*).

This Parrot is probably the species of which we have the earliest known record, as Onesicritus, who was admiral of the fleet of Alexander the Great, is said to have brought from Ceylon a specimen of a green Parrot with a red neck. Many authors have supposed that the large Alexandrine Parrakeet (*Palæornis eupatrius*, or *Alexandri*) was the species referred to, but the habitat of this bird is now

known to be the island of Java, and the Rose-ringed Parrakeet is more probably the bird intended. Professor Sundevall, the great authority on Aristotle, believes that the present bird was the only Parrot known to the ancients, being brought into Europe probably from Nubia. Other species were not seen in Europe before the end of the Middle Ages, and the West African species, such as the Senegal Parrot (*P. senegalus*), in 1455, and the Grey Parrot even later; the latter not being described before Aldrovandus, about the year 1600. American species were brought already in 1493 by Christopher Columbus, and many Indian species after the circumnavigation of Africa about the year 1500. The present bird is common in India and Ceylon, and is, moreover, one of the few species of birds which are common to the Indian Peninsula and the continent of Africa, as it is a well-known bird in Nubia and Abyssinia, and on one occasion a flock has been seen in the neighbourhood of Port Elizabeth in the extreme south of the continent. According to Dr. Jerdon, it is one of the most common and familiar birds in India, frequenting cultivated ground and gardens, even in the barest and least wooded parts of the country, and it is habitually found about towns and villages, constantly perching on the house-top. It is very destructive to most kinds of grain, as well as to fruit-gardens. Burgess says that they carry off the ears of corn to trees to devour at leisure, and Jerdon has observed the same sometimes. When the grains are cut and housed it feeds on the ground in the stubble cornfields, also in meadows, picking up what seeds it can; and now and then takes long flights, hunting for any tree that may be in fruit, skimming close and examining every tree; and when it has made a discovery of one in fruit, circling round, and sailing with outspread and down-pointing wings till it alights on the tree. It associates in flocks of various size, sometimes in vast numbers, and generally many hundreds roost together in some garden or grove. At Saugor all the Parrakeets, Mynahs, Crows, Bee-eaters, &c., of the neighbourhood, for some miles around, roost in company in a large grove of bamboos; and the deafening noise heard there from before sunset till dark, and from the first dawn of day till long after sunrise, gives to the listener the idea of numberless noisy steam machines at work. Many of the flocks of Parrots are very late in returning, and fly along quite low, skimming the ground, and just rising over a tree, house, or any obstacle in the way, and, for several nights in succession, several Parrakeets flew against the wall of a house, on the top of a hill in

ROSE-RINGED PARRAKEET.

Saugor, and were killed. The Rose-ringed Parrakeet breeds both in holes in trees, and very commonly in the south of India about houses, in holes in old buildings, pagodas, tombs, &c. It lays four white eggs. Its breeding season is from January to March. Adams states that he has seen this Parrakeet pillage the nests of the Sand Martin; but with what intent he does not guess at. Its ordinary flight is rapid, with repeated strokes of the wings, somewhat wavy laterally, or arrowy. It has a harsh cry, which it always repeats when in flight, as well as at other times. Mr. Philipps remarks that the Kite will sometimes swoop down on them when perched on a tree, and carry one off in its talons; also that Owls attack these birds by night.*

The length of this species is about sixteen inches and a half. It is green with a black band extending from under the chin backwards nearly to the nape, and having a rose-coloured collar round the hind neck. The bill is cherry-red, the feet greyish, and the iris pale yellow. The female does not possess the rose-coloured collar, but has instead a narrower one of emerald green.

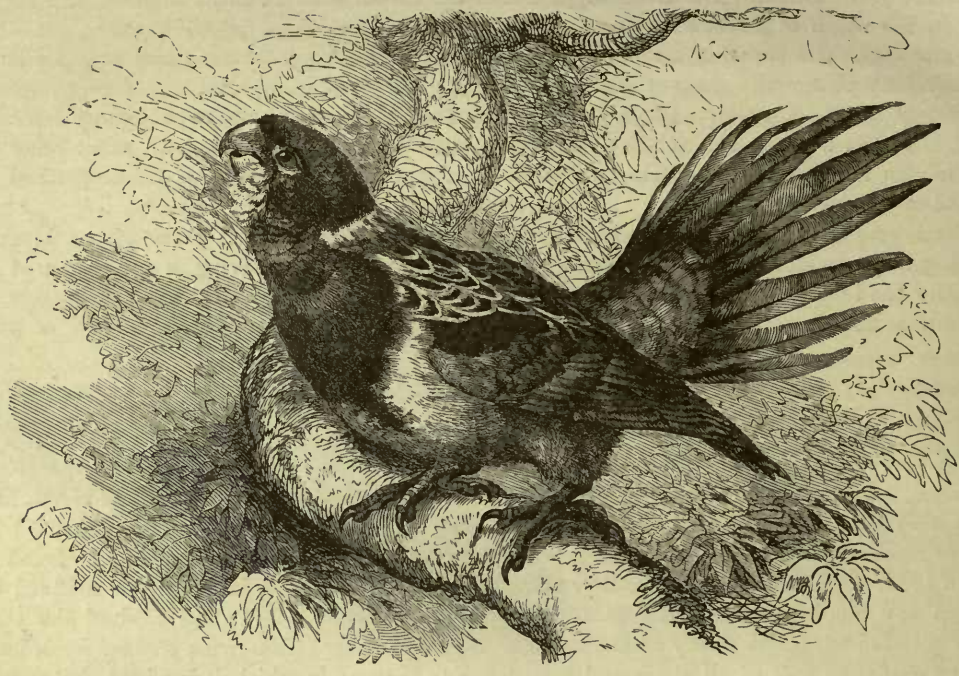
THE CAROLINA CONURE (*Conurus carolinensis*).

The Conures are inhabitants of the New World, and are very abundant in South America, but one species, the Carolina Conure, penetrating into the Nearctic region above the line of North Mexico. It is a very handsome bird, but is rapidly decreasing in numbers, and becoming restricted in its range, so much so, that in places where it was once plentiful it is now no longer to be found at all. Even in 1842, when Audubon wrote, they were then fast diminishing, and are now confined to the Southern and South-western States, as far west as the Missouri river. The food of the Carolina Conure is stated to consist chiefly of the seeds of the Cockle-burr (*Xanthirum strumarium*), but it is also very partial to fruit of all kinds, and it is owing to the way in which it has been shot down that it is now so rare, for Mr. Audubon describes the immense damage done by a flock of Conures to stacks of grain, which they covered in such numbers that they presented to the eye the same effect as if a brilliant-coloured carpet had been thrown over them. The farmers resented the attacks on their property to such an extent that the same naturalist states that he has seen hundreds killed in the course of a few hours, the survivors, after each shot, flying round for a few minutes, and then settling again in a place of most imminent danger. Even in confinement the birds seem to develop their destructive propensities, destroying wood, books, and, in short, everything that comes in their way, while from their incapability of talk, and their harsh, disagreeable voices, they are not much esteemed as pets. As Audubon observes, the woods are the habitation best fitted for them, and there the richness of their plumage, their beautiful mode of flight, and even their screams, afford welcome intimation that the darkest forests and most sequestered swamps are not destitute of charms. According to the same observer, they deposit their eggs, without making a nest, in the bottoms of such cavities in trees as those to which they usually retire at night. Many females deposit their eggs together, and he believed that the number laid by each hen bird was two; the eggs were greenish-white, and nearly round, and the young are at first covered with soft down, such as is seen in nestling Owls. The colour of this Parrot is green, the head and neck bright-yellow, and the forehead and region of the eye scarlet; the bill is white, the feet pale flesh-colour, and the iris hazel; the length of the bird being about fourteen inches. The female is like the male, but the young bird has the head green instead of yellow.

THE PARRAKEETS (*Platycercinæ*).

These form the fourth sub-family, and are remarkable for their slender, smooth tarsus, which is formed as in most birds; and the voice is more agreeable than in the other genera, the members of which, almost without exception, have a harsh and unpleasant cry. They are mostly inhabitants of Australia, whence come several of them well known as cage-birds, such as the King Parrakeet (*Platycercus scapulatus*), the Rosella, or Rose Parrakeet (*P. eximius*), and in America they are represented by the single genus *Bolborhynchus*.

* Jerdon, "Birds of India," I., p. 258.



ROSELLA.

THE OWL PARROT (*Strigops* habroptilus*†).

The genus *Strigops* is the sole representative of the fifth sub-family, the *Strigopinæ*. It is one of the most remarkable of all the Parrots, and is met with only in New Zealand. The face shows a disc exactly as in the Owls, whence the name, and the wing is very short, convex, and rounded. In its habits this bird is chiefly nocturnal, but not entirely so; the most remarkable fact connected with it being, perhaps, its unwillingness to fly. Thus Dr. Buller, F.R.S., in his excellent work on the "Birds of New Zealand," writes:—"All who have studied the bird in its natural state agree on this point, that the wings, although sufficiently large and strong, are perfectly useless for purposes of flight, and that the bird merely spreads them to break the force of its fall in descending from a higher point to a lower, when suddenly surprised; in some instances even this use of them is neglected, the bird falling to the ground like a stone. We are naturally led to ask how it is that a bird possessing large and well-formed wings should be found utterly incapable of flight. On removing the skin from the body it is seen that the muscles by means of which the movements of these anterior limbs are regulated are very well developed, but are largely overlaid with fat. The bird is known to be a ground-feeder, with a voracious appetite, and to subsist chiefly on vegetable mosses, which, possessing but little nutriment, require to be eaten in large quantities; and Dr. Haast informs us that he has sometimes seen them with their crops so distended and heavy, that the birds were scarcely able to move. These mosses cover the ground and the roots or trunks of prostrate trees, requiring to be sought for on foot; and the bird's habit of feeding at night, in a country where there are no indigenous predatory quadrupeds, would render flight a superfluous exertion, and a faculty of no especial advantage in the struggle for existence. Thus it may be reasonably inferred that *disuse*, under the usual operations of the laws of nature, has occasioned this disability of wing; for there is no physiological reason why the Kakapo should not be as good a flier as any other Parrot."

The Kakapo, as it is called in New Zealand, meaning a "Night Parrot," is becoming rarer every year, as the places which it affects become more and more accessible to the colonists. From the long accounts of its habits given in Dr. Buller's work, the following note of Dr. Haast is selected, as it

* στρίγξ, an Owl; ὤψ, a face, *i.e.*, having the appearance of an Owl. † ἁβρός, soft; πτίλον, feather.

gives a good idea of the habits of this singular species :—"So little is known of this solitary inhabitant of our primæval forests, that the following short narrative of observations, which I was fortunate enough to make during my recent West Coast journey, may interest you. Although I was travelling almost continuously for several years in the interior of these islands, it was only during my last journey that I was enabled to study its natural history. I was well acquainted with its call, and had often observed its tracks in the sands of the river-beds and in the fresh-fallen snow, but I had not actually seen it. The principal reason for this was, that formerly I had no dog with me; and consequently it would only be by the greatest accident that this bird, not at all rare in those untrodden regions, could be obtained. The true habitat of the Kakapo is the mossy *Fagus* forest, near mountain streams, with occasional grassy plots; but it also lives both on the hill-sides, amongst enormous blocks of rock, mostly overgrown with roots of trees and a deep covering of moss, and on wooded flats along the banks of the larger rivers, liable to be inundated by heavy rainfalls or by the sudden melting of the snow. . . . . It is a striking fact, that—with the exception only of the valley of the river Makarora, forming Lake Wanaka—I never found the Kakapo on the eastern side of the Alps, although extensive *Fagus* forests exist there also. It appears to have crossed the main chain at the low wooded pass which leads from the source of the Haast to that of the Makarora, and reached the mouth of this river at Lake Wanaka, where probably the absence of forest put a stop to its farther advance. It is very abundant in the valley of the last-mentioned river, and is found even in the Makarora bush, notwithstanding that numerous sawyers are at work there. When camped on the borders of that forest we continually heard its call near our tents; but none of the sawyers had any idea of the existence of such a large bird in their neighbourhood, although the irregular shrill call had sometimes attracted their attention. It also occurs in the valley of the Wilkin, but is less numerous there, which may be accounted for by the existence of wild dogs in this locality. We may therefore safely assume that from the junction of this river with the Makarora the Kakapo ascended toward the sources of the former. In the valley of the Hunter, only divided by a mountain-range of great altitude but with some low saddles, no sign of it was to be observed, although large *Fagus* forests would appear to offer a propitious abode. This bird has hitherto been pronounced to be of true nocturnal habits; but I think, from observations I was able to make, that this opinion ought to be somewhat modified. It is true that generally an hour after sunset, the dense foliage of the forest giving additional darkness to the country, its call began to be heard all around us. It then commenced to rove about, and, attracted by the glare of our camp-fire, frequently came close to our tent, when the heedless bird was immediately caught by our dog. But as we met with it on two occasions in the daytime, occupied in feeding, and as I observed that it knew and understood perfectly well the danger which approached, we may assume that it has, at least in this respect, some relation to diurnal birds. In order to show why I come to this conclusion, I will particularise the two occurrences I have mentioned, as they appear to bear directly upon some other important points in the structure of this bird. When returning from the West Coast, we observed in the afternoon (the sky being clouded) a Kakapo sitting on the prostrate trunk of a tree in the open forest. When about ten yards from it, the bird observed us, and disappeared instantly in its hole, whence, with the aid of the dog, we afterwards took it. It is clear that in this case the bird was not overtaken by the

OWL PARROT. (*After Keulemans.*)

coming day when far from its abode, but that it left its retreat voluntarily during daylight. The second instance I shall mention is more striking, and shows that the Kakapo feeds also during the day. It was towards evening, but still broad daylight, when we passed along the hill-side near a deep rocky gorge, and saw a large Kakapo sitting on a low fuchsia-tree, about ten feet from the ground, feeding on the berries. When close to it, the bird saw us, and instantly dropped down as if shot, and disappeared amongst the huge fragments of rocks strewed along the hill-side. But the most remarkable circumstance was, that the frightened bird did not open its wings to break its fall, but dropped as if it did not possess any wings at all. In order to see whether they would fly, or even flutter, when pursued by an enemy, I placed on the ground a full-grown specimen, which had been caught by the dog without being hurt. It was on a large shingle-bed, so that the bird had ample room for running or rising on the wing, if for this purpose it wanted space. I was not a little astonished to observe that it only started running towards the nearest point of the forest, where a dark shadow was apparent, and it went quicker than I had anticipated, considering the position of its toes and its clumsy figure, its gait resembling closely that of a Gallinaceous bird in its movements. As I was standing sideways to it, I thought that it kept its wings closed upon its body, so little were they opened; but my companion, who was equally anxious to see how our prisoner would try to escape, and who stood a little behind it, observed that it opened its wings slightly, but without flapping them in any degree, using them apparently more for keeping its balance than for accelerating its movements. This would almost lead to the conclusion that the Kakapo does not travel far, especially as I have already shown that its whole structure is ill adapted for running. But having myself frequently followed its tracks, and found them to extend a great distance over the sandy reaches along the river, such a conclusion as that suggested above would be erroneous. It must be exceedingly fond of water, because in many localities its tracks were observed for half a mile over shingle and sand to the banks of the river; and I am unable to explain the curious fact, unless the object be to mix river water with the enormous mass of pulpy vegetable matter which is to be found in its crop. With the exception of two specimens, the crops of which were filled with the large berries of a small-leaved *Coriaria*, by which their flesh was flavoured, all the birds examined by me had their crops widely distended by a mass of finely-comminuted vegetable mosses, weighing many ounces.

"I carefully examined the subterranean abode of this bird. From the account given by the natives, I thought that it would be found living in well-excavated holes, resembling in their construction those of the Fox or Badger; that the entrance would be so small as to enable only the inhabitants to enter, and thus to exclude larger animals from persecuting it. This, however, is not the case; because, with one exception, all the specimens obtained were either in fissures amongst rocks, or in cavities formed by huge blocks tumbled one over another, and overgrown with moss, or in holes formed by the roots of decayed trees. The cavities in the rocks were generally sufficiently large to allow of my dog, a good-sized Retriever, freely entering them. The openings to the other holes were smaller, and it was sometimes necessary to cut away a few roots at the entrance. Inside, the cavity was invariably of very large size, because we could plainly hear the dog advancing several yards before commencing his scuffle with the occupant; and on returning with the bird in his mouth, he always emerged head foremost, thus proving that the chamber was large enough to enable him to turn himself round. Before he had become accustomed to the work, the dog was often punished severely by the bird's powerful beak and claws; but he ultimately became quite an expert, always seizing his prey by the head and crushing the skull.

"The holes or abodes of the Kakapo were not only on the mountain sides, but also on the flats near the river banks which are liable to be overflowed. There can be no doubt that when a sudden inundation takes place the bird can save itself upon a bush or neighbouring tree. I do not think, however, that it can climb the boles of standing trees, because it never resorted to them during the night or when persecuted by the dog—except in one single case, when the bird ascended a leaning tree close to our camp, and remained till the dog had given up the attempt to obtain it. But, notwithstanding that almost all the abodes that came under examination were natural cavities, I met with one hole that seemed to have been regularly mined. On the northern bank of the river Haast, just below the junction of the river Clarke, a large flat occurs, formed by deposits of sand, over which a thin layer of vegetable mould is spread, and on which a luxuriant vegetation has sprung up. The

river, in washing against these deposits, has in some cases formed nearly perpendicular banks, about six to eight feet high. At one spot, about two feet below the surface, several rounded holes were observed, and the dog tried in vain to enter them. After carefully scenting the ground, he began to scratch the surface with his paws, and soon succeeded in widening the entrance sufficiently to admit his body, and he immediately afterwards emerged with the bird in his mouth. There is no doubt in my own mind that this hole at least had been excavated; and the burrowing faculty of the bird may be considered so far established. On a flat in the valley of the Makarora, the dog brought one from the interior of a hollow drift-tree, which was lying amongst sedges and grasses in an old river channel. There never was more than one individual in the hole, although very often, within twenty or thirty yards of it, another specimen would be scented out by the dog, the two being generally of opposite sexes. At night-time, in visiting our camp fire, they generally came in pairs, the two being successively caught by my dog, a single or sometimes a repeated angry growl from the bird informing us that he had hold of it. These circumstances lead me to conclude that during the day each inhabits separately its own hole, and that only after dark do they meet for feeding and for social intercourse."

In size, the Owl Parrot is about twenty-six inches in length, and is of a dark sap-green colour, varied and mottled with dark brown and yellow; the face is lighter, being darker brown, the ear-coverts mixed with yellow; the belly and under tail-coverts, as well as the wing-lining, are rather brighter yellow than the rest of the under surface. The tint of green varies a good deal: from light yellowish to dark sap-green.

THE STRAIGHT-BILLED PARROTS (*Psittaci orthognathi*).*

In this second section of the Parrots only one family is known, all the members of which are easily recognisable by their straightened bills, the lower mandible being gently compressed, and not

LORIKEET.

bulged out, with a nearly straight tip, the cutting edges with scarcely any indentation. With the exception of the Lorikeets (*Loriculus*), members of which are found in India and the Indo-Malayan region, the whole family is Australian, being confined to that continent and the adjacent Molucca Islands, New Zealand, and the islands of Polynesia.

* ὀρθός, straight; γνάθος, jaw.

THE BRUSH-TONGUED PARROTS.*

The Brush-tongued Lorikeets are all birds of very beautiful colouring, and are mostly found in Australia, the Moluccas, some few species extending through the Oceanic Islands. All seem to be very similar in their habits, an account of which is given by Mr. Gould. He says:—"This arboreal group of honey-eating Lorikeets, if not so numerous in species as the seed-feeding Parrakeets, is individually as abundant, and more universally dispersed, being found in every part of Australia yet visited. In their structure, habits, food, and mode of nidification, no two groups of the same family can be more widely different than these forms: the pencilled tongue, the diminutive stomach, thick skin, tough flesh, and fœtid odour of the *Trichoglossi* presenting a decided contrast to the simple tongue, capacious crop and stomach, thin skin, delicate flesh, and freedom from odour of the *Platycerci;* besides which, the *Trichoglossi* possess a strong *os furcatorium*, which bone is wanting in the *Platycerci.* Hence, while the *Trichoglossi* are powerful, swift, and arrow-like in their flight, the *Platycerci* are feeble, pass through the air in a succession of undulations near the ground, and never fly to any great distance. The mode in which the two groups approach, alight upon, and quit the trees is also remarkably different—the *Trichoglossi* dashing among and alighting upon the branches simultaneously and with the utmost rapidity, and quitting them in like manner, leaving the deafening sound of their thousand voices echoing through the woods; while the *Platycerci* rise to the branch after their undulating flight, and leave them again in a quiet manner, no sound being heard but their inward piping note. The eggs of the *Trichoglossi* are from two to four in number; those of the others are more numerous."

THE NESTORS (*Nestor*).

These Parrots, which are only found in New Zealand, are generally placed with the other Brush-tongued Parrots. "In all Parrots the fleshy tongue ends anteriorly in a dilated portion, supported by a narrower neck. This tip is much like the end of a human finger, as mentioned by most observers; and its function is similar also, for it is employed by the bird as a third prehensile organ in connection with the upper and lower beak, any solid substance being held by the tongue and upper beak, while the mandible is freed to give another bite. Continuing the simile of the finger, the tip is directed forwards with the nail-like portion downwards, the part corresponding to the free edge of the nail appearing along the lower margin of the anterior rounded surface.† In the *Trichoglossi*, this 'nail,' or horny plate, is stated to be present; but on the superior surface of the tongue, between the lateral edges of the unguis, or nail, there is an arrangement of retroverted papillæ, forming a spinous covering, and their mechanism is such that when the tongue is protruded beyond the mouth to grasp any object, the papillæ stand upright, or are even directed somewhat forward. In Nestor," continues Professor Garrod, "there are no papillæ of this description; but the tongue is here, as Dr. Buller says, 'soft, rounded on the edges, with a broad central groove,' and it is as smooth as in other Parrots. Therefore, the Kaka Parrot cannot in this point be said to approach the *Trichoglossini* (badly so called). The peculiarity of the tongue of *Nestor* consists in the fact that the interior edge of the unguis, or nail, always free (though for a very short distance) and jagged in the other birds of the class, is here prolonged forwards beyond the tips of the tongue for about one-tenth of an inch, as a delicate fringe of hairs with a crescentic contour. In the living bird the mouth is moist, as in the Lories, and not, as in the Cockatoos and others, dry and scaly."

TONGUE OF NESTOR. (*After Garrod.*)

The members of the genus *Nestor* are entirely confined to New Zealand, the species of Philip Island (*Nestor productus*) being now extinct. Their habits, like those of all New Zealand birds, are sufficiently curious, one of them, known as the "Kea" (*N. notabilis*), actually feeding on raw flesh, as is noticed by Dr. Buller:—"Those that frequent the sheep stations appear to live almost exclusively on flesh. They claim the sheep's heads that are thrown out from the slaughter-shed, and pick them perfectly clean, leaving nothing but the bones." An eye-witness described this operation to Dr. Hector as follows:—"Perching itself on the sheep's head or other offal, the bird proceeds to tear off

* *Trichoglossi.* † Professor Garrod in *Proceedings of the Zoological Society for* 1872, p. 787.

the skin and flesh, devouring it piecemeal, after the manner of a Hawk; or at other times holding the object down with one foot, and with the other grasping the portion it was eating, after the ordinary fashion of Parrots." Dr. Buller also mentions instances of tame Parrots devouring their comrades in captivity; but the Kea is the only Parrot known to eat flesh when flying wild.

THE KAKA PARROT (*Nestor meridionalis*).

This Parrot is best described by the above-named ornithologist in the work on the Birds of New Zealand, to which frequent reference has been made in these pages:—"Sprightly in its actions, eminently social, and more noisy than any other inhabitant of the woods, the Kaka holds a prominent place among our native birds. Being semi-nocturnal in its habits, it generally remains quiet and concealed during the heat of the day. If, however, the sportsman should happen to find a stray one, and to wound instead of killing it, its cries of distress will immediately rouse the whole fraternity from their slumbers, and all the Kakas within hearing will come to the rescue, and make the forest echo with their discordant screams. Unless, however, disturbed by some exciting cause of this sort, they remain in close cover till the approach of the cooler hours. Then they come forth with noisy clamour, and may be seen, far above the tree-tops, winging their way to some favourite feeding-place; or they may be observed climbing up the rough vine-clad boles of the trees, freely using their powerful mandibles, and assuming every variety of attitude, or diligently tearing open the dead roots of the close epiphytic vegetation in their eager search for insects and their larvæ. In the spring and summer, when the woods are full of wild blossom and berry, these birds have a prodigality of food, and may be seen alternately filling their crops with a variety of juicy berries, or sucking nectar from the crimson flowers of the rata (*Metrosideros robusta*) by means of their brush-fringed tongues. With the earliest streaks of dawn, and while the underwoods are still wrapped in darkness, the wild cry of this bird breaks upon the ear with a strange effect. It is the sound that wakes the weary traveller encamped in the bush; and the announcement of his ever active Maori attendant—'Kua tangi te Kaka'—is an intimation that it is time to be active. But although habitually recluse during the day, it is not always so.

KAKA PARROT.

"During gloomy weather it is often very active; and sometimes even in the bright sunshine a score of them may be seen together, flying and circling about high above the tree-tops, uttering their loud screams, and apparently bent on convivial amusement. When the shades of evening bring a deeper gloom into the depths of the forest, and all sounds are hushed, save the low hoot of the waking Morepork, or the occasional *cheep-cheep* of the startled Robin, the Kaka becomes more animated. It may then be heard calling to its fellows in a harsh rasping note, something like the syllables '*t-chrut, t-chrut,*' or indulging in a clear musical whistle with a short refrain. It is strictly arboreal in its habits, and subsists to a large extent on insects and their larvæ, so that it is probably one of our most useful species. Where they exist in large numbers they must act very beneficially on the timber forests; for in the domain of Nature important results are often produced by apparently trivial agencies. Like all the honey-eaters, while supplying their own wants, they do good service with their brush tongues by fertilising the blossoms of various trees, and thus assisting in their propagation; while, on the other hand, the diligent search they prosecute for insects and grubs, and the countless numbers daily consumed by each individual, must materially affect the economy of the native woods. On this latter point Mr. Potts has furnished the following valuable note:—'Although so often accused of injuring trees by stripping down the bark, from careful observation we do not believe a flourishing tree is ever damaged by its beak. It is the apparently vigorous, but really unsound, tree that is attacked, already doomed by the presence of countless multitudes of insects of many varieties, of which it is at once the food and refuge, either in their perfect or larval state. In the persevering and laborious pursuit of this favourite food, the Kaka doubtless lends his assistance in hastening the fall of decaying trees; the loosened strips of bark dissevered admit to the exposed wood rain and moisture collected from dews and mists, to be dried by evaporation by the heat of the sun, by the desiccating winds, only to become saturated again. Under this alternation the insidious fungi take root, decay rapidly sets in, the close-grained timber gives place to a soft spongy texture, branches drop off, and gradually the once noble-looking tree succumbs to its fate; but its gradual decay and fall, the work of years, has proved beneficial to the surrounding plants: the dropping of the branches admits light and air to the aspiring saplings, assists in checking the undue spread of lichens and epiphytes; and when the old stem falls, tottering down from its very rottenness, its place is supplied by vigorous successors.'

"In estimating the value of the labours of the Kaka as an insect-eater, it should not be forgotten that the family of Woodpeckers is entirely absent from our bird-fauna, and that upon this indefatigable climber devolves some share of the duty of representing that peculiar group of forest birds. How diligently the insects are sought for by the Kaka may be judged from the heaps of bark chips that lie beneath the decaying trees. Often it may be noticed on the ground tearing away the mossy clothing of the huge gnarled roots that spread around; even the soft rotten boughs are gnawed to obtain the larvæ of some of the larger bush insects."

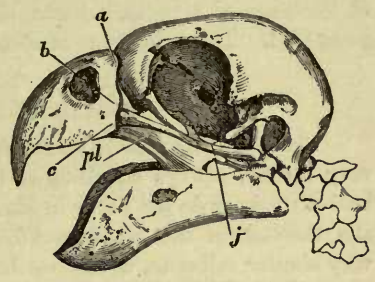
The Nestors vary immensely in colour, so that many of the plumages now known to be only occasional varieties have been supposed to be specifically distinct. They are birds of large size, and have the cere, or fleshy portion at the base of the bill, rather strongly developed, the bill being large and powerful. The colour is of an olivaceous brown, with a dash of dark red, the crown grey, and the ear-coverts shaded with orange, the cheeks with dark red, as also are the lower back, rump, and upper tail-coverts and abdomen.

The structure of the bill of the Parrots is so remarkable as to be worthy of a more extended description than could be given to it when it was incidentally referred to in our account of the osteology of birds in general. The way, however, in which the upper and lower jaws are connected with the skull was there explained, and a reference to the description on pp. 241–2 will save the necessity of much repetition now. That account embraced all members of the class of birds; here we are dealing only with certain peculiar modifications.

If the skull of an adult bird of any familiar type, such as a Crow, be examined, it will be seen that the bones of the upper jaw are apparently continuous, and form one piece, with those of the forehead and sides of the head. There is nothing that looks like a joint, or "articulation," between the bill where it is attached to the forehead above, or to the long jugal arch ("quadrato-jugal") that runs each side to reach the quadrate bone, or to the flattened bones that help to

form the palate below. But if the skull of this same bird had been carefully examined in an earlier stage of its existence, it would have been found that the bones were at first distinctly separate at the three points here indicated, and were merely connected by a soft membranous substance. In many birds this "inter-osseous" membrane connecting the bones of the upper mandible with the skull proper never becomes true bone at all, but remains throughout life more or less soft and flexible. And by this means a sort of elastic joint is established, conferring upon the beak a certain range of up and down motion.

Now in Parrots, more conspicuously than in any other birds, each of these joints, not alone that of the beak with the forehead, is converted into a true hinge-like articulation, so that the upper jaw can be raised to a very considerable extent; and to effect this motion the muscles of the palate are developed into a somewhat complex apparatus.



SKULL OF THE GREY PARROT.

If the figure be examined, the actual relations of the bones can be readily made out. At *a* is seen the line where the bill is articulated to the frontal bones. At *b* is the joint which the bill makes with the long jugal bone (*j*). And at *c* is its articulation with the palatine bone (*pl*).

But it is not this mobility of the upper mandible alone that gives the characteristic aspect to the Parrot's face. There are several other points in which Parrots agree, with a wonderful uniformity, among themselves, and differ from most other birds. Besides the absence of certain important processes, called "basi-pterygoid," the ploughshare-like bone, or "vomer," is altogether wanting. The maxillo-palatines are very largely developed and spongy; they unite with one another in the middle line, and with the thick wall of bone into which the *septum nasi* is in Parrots strongly ossified, and thus fill up almost the whole base of the beak. The long palatine bones proper are remarkably flattened from side to side for most of their length; their hinder edges are more or less notched, and quite free from any bony attachment; and they are united at about the hinder third of their length by a plate-like extension from each. The scoop-like lower mandible, with its tip that seems to have been cut off "square," to be out of the way of the strongly-hooked upper jaw, is too familiar to call for any particular description.

THE SECOND ORDER.—PICARIAN BIRDS. SUB-ORDER I.—ZYGODACTYLÆ.

CHAPTER VIII.

CUCKOOS—HONEY GUIDES—PLAINTAIN-EATERS—WOODPECKERS—TOUCANS—BARBETS.

THE CUCKOOS—The Bush Cuckoos—The Lark-heeled Cuckoos, or Coucals—The Common Cuckoo—Its Characteristics—Mrs. Blackburn's Account of a Young Cuckoo Ejecting a Tenant—Breeding Habits—The Eggs—The Call-notes of Male and Female—Food—Its Winter Home—Its Appearance and Plumage—THE HONEY GUIDES—Kirk's Account of their Habits—Mrs. Barber's Refutation of a Calumny against the Bird—THE PLANTAIN-EATERS—The White-crested Plaintain-eater—The Grey Plantain-eater—The Colies—The White-backed Coly—THE WOODPECKERS—How they Climb and Descend Trees—Their Bill—Do they Damage Sound Trees?—The Wrynecks—The Yaffle—The Red-headed Woodpecker——The Spotted Woodpecker—THE TOUCANS—Mr. Gould's Account of their Habits—Mr. Waterton's Account—The Enormous Bill—Azara's Description of the Bird—Mr. Bates' History of a Tame Toucan—THE BARBETS—Messrs. Marshall's Account of the Family—Mr. Layard on their Habits.

THE SECOND ORDER OF ZYGODACTYLE PICARIAN BIRDS.—THE CUCKOOS (*Cuculidæ*).

Within the limits of this family are comprised birds of very different habits and of very different structure, some being inhabitants of the ground and of the thick bush, whilst others are lovers of the open, and are birds of very strong flight. Without being able to climb up the trunks of trees,

like our Woodpeckers, the Cuckoos possess the zygodactyle foot of the climbing bird in a very perfect degree. They differ from others of the Scansorial group by the position of the nostrils, which are placed rather low in the upper mandible, not far from the cutting edge of it. There are three sub-families of Cuckoos, distinguished by the form of the wing: the first of these has the wings short, rounded, and with from two to six, or even seven, of the primaries slightly indented in the middle. They have the feathers of the thigh close-set, and not over-hanging like those of a Hawk, as is the case with the true Cuckoos.

THE BUSH CUCKOOS (*Phænicophæinæ*).

These birds have representatives in India, Australia, and Africa, and even South America. Some of them are of very varied and beautiful plumages, and many of them reach the size of a moderate game-bird. The first genus of these Bush Cuckoos contains

THE LARK-HEELED CUCKOOS, OR COUCALS (*Centropus*).

These are remarkable for the form of the hind toe, which is furnished with a straight nail or claw, very strong, always equalling and often surpassing the length of the hind toe itself. These Lark-heeled Cuckoos do not occur in Europe, but are found all over Africa, India, and Burmah, to China, and throughout the Malayan Archipelago to Australia. They frequent the thick bush, and have a very similar call-note, which has been rendered by some observers as resembling the syllables "*bop bop*," while on the West Coast of Africa, from their cry "*hoot, hoot*," they have been nicknamed by the colonists the "Scotchman." Writing of the Eyebrowed Lark-heel, Mr. Thomas Ayres says:—"This bird frequents the dense bush, and principally lives amongst impenetrable creepers, where it hunts about in search of the insects which it feeds upon; if disturbed, it flies but a short distance. The note is a loud, melancholy, cooing noise; they call most in wet weather. They are fond of getting up into trees that are covered with creeping plants, and sunning themselves; they generally fly on to the lower part, and then gradually hop upwards till they gain the top, but they can fly a very short distance at a time, and are easily caught if chased out into the open grass, though they lie very close, and it requires a good dog to find them. If disturbed, they immediately fly to the thickest cover near at hand, and commence running, like the Rails." Mr. Ayres says that they feed on Grasshoppers, Caterpillars, and other insects; but Mr. Rickard, another excellent field naturalist, in South Africa has found a small Snake and Locusts in their stomachs, one having a small bird—a White-eye (*Zosterops*)—inside him. The Lark-heeled Cuckoos are not parasitic, like the true Cuckoos and many others: that is to say, they build their own nests, and do not employ the nests of other birds to place their eggs in. When hatched, the young birds are very curious, being covered with long hairs and bristles. In colour the Lark-heels are for the most part rufous, with black heads, but some of them are almost entirely rufous, the shafts of all the feathers much stiffened, so that the plumage lies very close, which must be of advantage to birds who have to climb a great deal amongst the lianas and creepers of tropical forests.

Of the Indian Coucal (*Centropus bengalensis*) an interesting account is given by Mr. Gammie, which affords a very good idea of the habits of these Bush Cuckoos. He says:—"This species has increased largely of late. Among grassy scrub, up to 3,500 feet, it is now abundant, where, only a few years ago, it was rarely to be found. In the earlier part of the rainy season its odd, monotonous notes are to be heard in every direction. I am not sure that the male calls, but have shot the female—as I found by dissection—when calling. It has a call of a double series of notes: '*whoot, whoot, whoot, whoot;*' then, after a pause of four or five seconds, '*kurook, kurook, kurook, kurook.*' The 'whoot' is quite ventriloquistic, sounding as if it came from a distance of six or seven yards from the bird. Before calling, it seats itself about five feet from the ground; then you see it draw its neck and body together, slightly puffing out its body-feathers, raising its back, and depressing its tail, and for every 'whoot' there is a violent throb of the body, as if the bird was in great pain; at the same time the motion of the throat is scarcely perceptible, and its bill is closed. Then, as if greatly relieved, it stretches itself out, the feathers fall smooth, and with open mouth and throbbing throat comes the 'kurook,' without the slightest attempt at ventriloquism. When searching for the caller, one must take no notice of the 'whoot,' but wait for the 'kurook.'

It feeds almost entirely on Grasshoppers, and frequents the open, scrubby tracts only. I have never once seen it in larger forests."*

The Malkohas are another remarkable group of the Bush Cuckoos, and are found throughout India, Ceylon, the Indo-Malayan region and islands, as far as the Celebes. The genera differ principally in the shape of the nostril; and although differences of structure are usually considered sufficient characters on which to found distinctions of genus, some ornithologists are of opinion that the variation in the form of the nostril only separates them as species. One of the most remarkable of these Bush Cuckoos is the *Carpococcyx radiatus* of Borneo, which, when alive, is stated by Mr. Wallace to resemble a Pheasant in appearance and gait. It lives much on the ground, and is often caught by the Malays in the snares which they set for Argus Pheasants and other game-birds. In Madagascar they are represented by the Couas (*Sericosomus*), of which there are no less than ten species found in that island. They are the inhabitants of the Palestrina forests, where their monotonous notes are often heard. The cry of the Blue Cuckoo is said by Messrs. Pollen and Van Dam to resemble the syllables *cir-cir-cir*, while that of the Crested Coua (*S. cristatus*) is *toc-toc-toc*. When calling, the latter bird raises its crest and flaps its tail and wings. Its flight is difficult and generally descending, and the bird never flaps its wings when it flies. It is ordinarily seen on the lower branches of the trees, and loves to repose during the great heat of the day in the sheltered parts of the trees, resting on the branches and puffing out its feathers.

In America there are several allied forms of Bush Cuckoos, many of which frequent the ground, one of the most interesting being the *Geococcyx californianus*, which is called the "Road-runner," and is a bird of such powers of running that it is sometimes hunted on horseback and pursued with hounds, a test of fleetness in which it is said often to make a longer race than its pursuers anticipated.

THE COMMON CUCKOO (*Cuculus canorus*).

The true Cuckoos, of which the English bird is the type, differ from the Bush Cuckoos in being more *Accipitrine*, or Hawk-like, in their appearance, and having long thigh-feathers, like the majority of the birds of prey. The nostril is swollen and rounded. It would be easy to write a complete book on this mysterious bird, whose habits and cry have rendered it an object of interest in all countries and from very early times. The popular superstition concerning the nestling—that the young Cuckoo, when sufficiently grown, and having no further use for the little foster-parent to whose care it owed its life and well-being, used to devour the latter—has often been held up as an "awful example" to ungrateful children who become a burden and a shame to their parents when they are unable to provide for them any longer. The idea of the young Cuckoo devouring its protector is no doubt erroneous, and, as Brehm puts it, has arisen from the oft-recurring spectacle of a little Wren or a diminutive Gold-crest placing food in the wide-gaping mouth of the young Cuckoo, which, indeed, without much stretch of the imagination, might swallow it. In Mr. Gould's "Birds of Great Britain" there is a picture showing the *dénouement* of the young Cuckoo's story, when, still callow and blind, it is represented as disposing of some unfortunate little Tree Pipits which were hatched along with it in the same nest. This incident was sketched by Mrs. Hugh Blackburn, who thus describes the occurrence:—"The nest (which we watched last June, after finding the Cuckoo's egg in it) was that of the common Meadow Pipit (Titlark, Mosscheeper), and had two Pipit's eggs besides that of the Cuckoo. It was below a heather bush on the declivity of a low abrupt bank or highland hill-side, in Moidart. At one visit the Pipits were found to be hatched, but not the Cuckoo. At the next visit, which was after an interval of forty-eight hours, we found the young Cuckoo alone in the nest, and both the young Pipits lying down the bank, about ten inches from the margin of the nest, but quite lively after being warmed in the hand. They were replaced in the nest beside the Cuckoo, which struggled about till it got its back under one of them, when it climbed backwards directly up the open side of the nest, and hitched the Pipit from its back on to the edge. It then stood quite upright on its legs, which were straddled wide apart, with the claws firmly fixed half-way down the inside of the nest among the interlacing fibres of which the nest was woven, and

* "Stray Feathers," 1877, p. 385.

stretching its wings apart and backwards, it elbowed the Pipit fairly over the margin so far that its struggles took it down the bank instead of back into the nest. After this the Cuckoo stood a minute or two, feeling back with its wings, as if to make sure that the Pipit was fairly overboard, and then subsided into the bottom of the nest. As it was getting late, and the Cuckoo did not immediately set to work on the other nestling, I replaced the ejected one and went home. On returning next day, both nestlings were found dead and cold out of the nest. I replaced one of them, but the Cuckoo made no effort to get under it and eject it, but seated itself contentedly on the top of it. All this I find accords accurately with Jenner's description of what he saw. But what struck me most was this: the Cuckoo was perfectly naked, without the vestige of a feather, or even a hint of future feathers; its eyes were not yet opened, and its neck seemed too weak to support

COMMON CUCKOO.

the weight of its head. The Pipits had well-developed quills on the wings and back, and had bright eyes, partially open; yet they seemed quite helpless under the manipulations of the Cuckoo, which looked a much less developed creature. The Cuckoo's legs, however, seemed very muscular, and it appeared to feel about with its wings, which were absolutely featherless, as with hands; the spurious wing (unusually large in proportion) looked like a spread-out thumb. The most singular thing of all was the direct purpose with which the blind little monster made for the open side of the nest, the only part where it could throw its burden down the bank. I think all the spectators felt the sort of horror and awe at the apparent inadequacy of the creature's intelligence to its acts that one might have felt at seeing a toothless hag raise a ghost by an incantation. It was horribly 'uncanny' and 'gruesome!'"

The above account of Mrs. Blackburn's graphically describes the ejection of its foster-brothers and sisters by the nestling Cuckoo; and this brings us to the next part of the subject, viz., the breeding habits of this curious bird. As is well known of the hen bird, it never makes its own nest, but it is believed that during its stay in Europe it lays altogether about eight eggs, all of which are deposited

in the nest of some other bird. The variation in the colour of the Cuckoo's eggs is very great, from a white speckled egg, like that of the Water Wagtail, or the dark brown mottled egg of a Lark or Pipit, to the blue egg of the Hedge Sparrow; while Mr. Dresser states that he has seen even green eggs, and is of opinion that the same female will lay similarly coloured eggs. The researches of ornithologists during recent years sufficiently prove that the female Cuckoo lays her egg upon the ground, and then deposits it in the nest of a bird whose egg resembles the one she has just laid; hence it is probable that a hen Cuckoo killed with a broken egg in its mouth is the rightful owner of the latter, and has not been sucking the eggs of some other bird, as the species is often supposed to do. The writer has on many occasions found Cuckoos' eggs in the nest of the Water Wagtail in Berkshire, the latter bird being frequently selected by the Cuckoo as her victim; and he can affirm that the eggs were in all cases similar to those of the Wagtail, but were a little larger in size. In due time the young Cuckoo is hatched, the rightful owners of the nest ejected, and for weeks the powers of the unhappy foster-parents are exercised to the utmost in feeding the gaping and constantly-complaining occupant of their domain. Even when the young Cuckoo has outgrown the nest, and is strong enough to fly about, he is still attended by his foster-parents. So great is the instinct of the young Cuckoo to receive food from other birds, that a specimen in the Zoological Gardens which managed to live through the winter and put on his full plumage in the following spring, on the appearance of a Hedge Sparrow in the same aviary, fluttered down, and with drooping wings and open bill solicited food from his small companion.

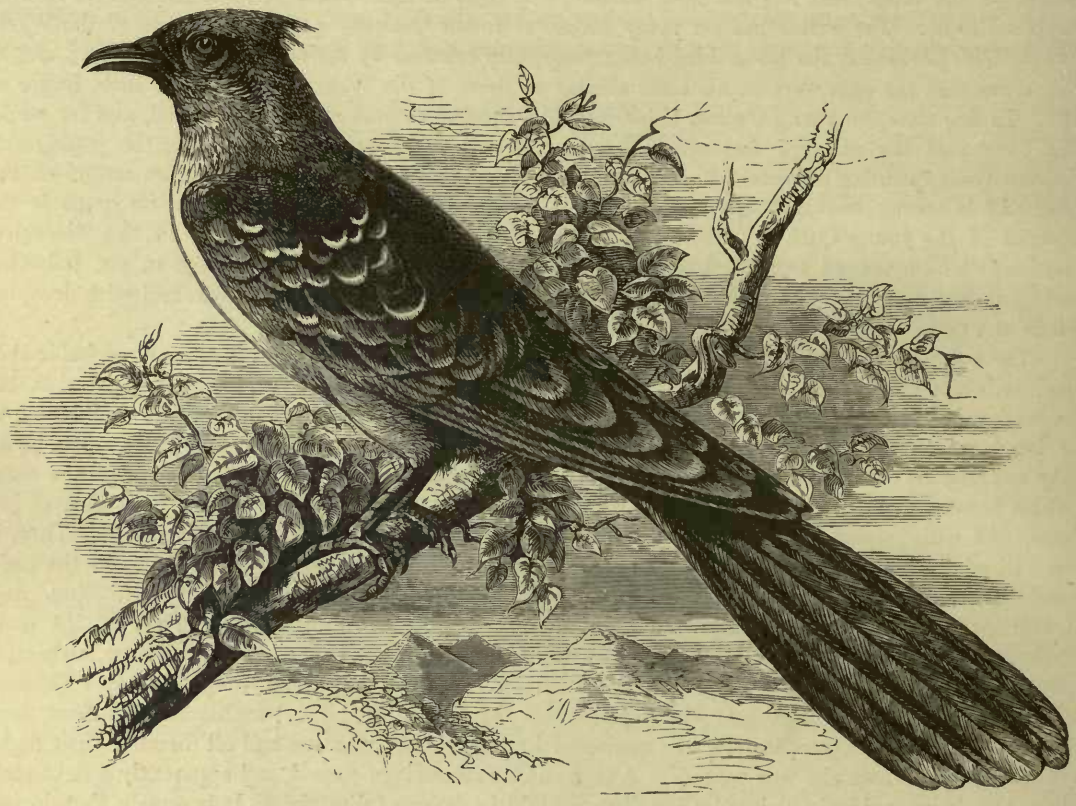
The reason for the parasitic habits of the Cuckoo is hard to discover, but it appears probable that the number of males greatly exceeds that of the females, and one observer has calculated that the preponderance of the former sex over the latter is as much as twenty-five to one. This would seem to be too large an estimate, but the proportion is probably about five males to one female. The latter may not only be distinguished by its somewhat darker plumage, and a certain red colour on the chest (which is more apparent when the bird is alive), but has a somewhat different note from that of her mate, and calls *cuckoo* in a much sharper and less emphasised way than the male bird. Thus, if the call of the female be represented by the syllables *cŭck-oo*, the responsive utterance of the male would be *coo-coo*. The female has also another call-note, which may be described as "whittling," and is well expressed by Brehm as *kwikwikwik*, the sound of which is quite sufficient to set all the male Cuckoos within hearing cuckoo-ing with might and main. Thus it happened to the writer, on a still, quiet evening in spring a few years ago, to be fishing beneath a large elm-tree on the river Thames, when a female Cuckoo flew into the topmost boughs and uttered her peculiar note. From four different points of the compass she was answered by male birds, who one and all directed their flight toward the tree where she was perched. A tremendous scrimmage ensued, and apparently a fight took place, but, being suddenly alarmed, they all took flight in different directions. It is certain that during the breeding season the Cuckoo is a very passionate bird, and loves to call until, from sheer hoarseness, he is obliged to stop; sometimes his cry comes from the middle of a thickly-wooded tree, at other times he will sit on a bare dead branch, or swing in the breeze from the top of a fir-tree. The female bird is more retiring and keeps nearer the ground, so that it is possible to shoot her by hiding behind a tree as she hunts after insects near one of their favourite haunts. The same plurality of males has been observed by the author during the spring at Avington Park, in Hampshire; and on one occasion, when the female was shot, the note of the males was scarcely heard again, as if they had disappeared from the vicinity.

Brehm remarks :* "The note itself, and the manner in which it is emitted, are typical of the bird's habits and character. The same abruptness, insatiability, eagerness, the same rage, are noticeable in its whole conduct. The Cuckoo is a greedy feeder, and a discontented, ill-conditioned, passionate fellow: in short, a decidedly unamiable bird. Its food consists entirely of insects and their larvæ; young Cuckoos, alone, will sometimes eat berries; Cockchafers, Fern-beetles, Moths, and Dragon-flies are favourite morsels, and Caterpillars (especially the hairy species, which no other birds ever devour) being preferred. The hairs of these creatures cling so close to the inner membranes of the stomach that the use of the magnifying glass is necessary to convince one that they do not form part and parcel of that organ. Its keen sight enables the Cuckoo to see Caterpillars from a great distance,

* "Bird-life," p. 595.

when it flies quickly to the spot, seizes them, and returns to its perch, without spending much time over the operation or climbing about after them. The bird is so constantly on the move that it always manages to obtain sufficient food—which is saying a great deal, for its stomach is large and its powers of digestion almost unlimited. Thus it would be a most useful bird, did it not cause so much damage while breeding."

The Cuckoo resembles a Hawk so much in flight that even a practised eye sometimes fails to distinguish it from a Kestrel at first sight. There is, however, a certain pointed look about the body



GREAT SPOTTED CUCKOO.

of the bird which distinguishes it from a Hawk; if near enough, the flat, obtuse head of the latter making the bird appear as if it had no head at all.

Lastly, one word as to the winter home of the Cuckoo. It is always known in England as the "harbinger of spring," and with the exception of the Swift, who very rarely makes a mistake in the period of his advent, there is no bird whose arrival may be considered so certain a sign of that genial season of the year. Just as the Swifts, however, sometimes come in for some cold weather, which proves fatal to many of them. so the Cuckoos have been known to have been detained by cold winds in the south of England, where they have remained in flocks until the weather was more seasonable and they could distribute themselves over the country. They are seldom heard of in the height of summer; and, as the old rhyme says, "in June he changes his tune, in August go he must." And it seems certain that this bird leaves England early in that month, but not entirely, as young birds—perhaps the later offspring—are seen as late as September. The old ones arrive in Egypt on their way south before the young birds, which are somewhat later; and in Berkshire the writer shot three young Cuckoos during the first week in August, a few years ago, out of a flock of birds on migration, which, like himself, had apparently taken shelter under a wood from an approaching thunderstorm. These specimens are now in the British Museum, and are of slightly different ages.

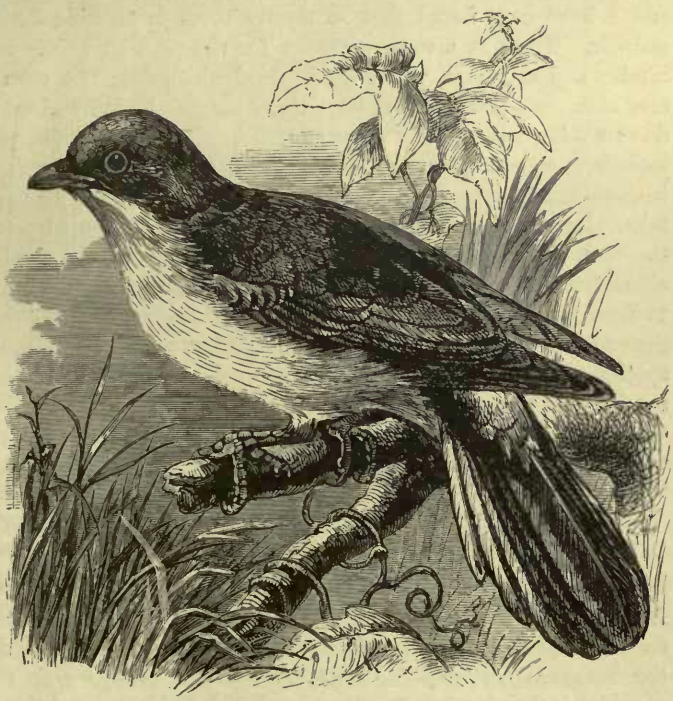
The Cuckoo is a well-known bird at the Cape of Good Hope during the English winter, and specimens are in the national collection. It is much rarer on the west coast of Africa, but was shot by Governor Ussher near Cape Coast Castle, evidently on migration. The main route of the birds visiting the Cape in winter is, however, evidently down the Nile Valley and along the east coast to the Cape Colony and South Africa generally. A second line of migration extends to India, and it probably goes further, and has been found in the island of Celebes. In Asia, however, and Australia, there are several species of Cuckoo, very like the English bird, but smaller and differing in voice, which have not been sufficiently studied to enable one to say whether they are actually distinct or not.

The Cuckoo when adult is ashy-grey, with a white breast, barred across with narrow lines of greyish-black; the tail is long, barred with white on the outer feathers, and spotted with white on the centre ones; the bill is black, with a little yellow at the gape and at the base of the lower mandible; the feet and the eye are yellow; the length of the bird is about thirteen inches. The female is a trifle smaller, and has the chest slightly tinged with rufous. The young bird is quite different, being blackish, mottled with yellow and grey, and having a good deal of white about the hind neck. Rarely in England, but more often on the Continent, the Cuckoo is red instead of grey, and this is called the "hepatic" plumage. It is found also in Owls, Goatsuckers, and a few other birds, and exists in almost all the true Cuckoos.

THE THIRD FAMILY OF THE ZYGODACTYLE PICARIAN BIRDS.

THE HONEY GUIDES (*Indicoridæ*).

These constitute a small family of Scansorial birds allied to the Cuckoos, and, like the latter, they are parasitic, and lay their eggs in other birds' nests. Eleven species are known, of which eight are peculiar to Africa, one is found in the Himalaya Mountains, one in the Malayan Peninsula, and one in Borneo. The Asiatic members of the group are extremely rare, and our knowledge of the habits of these birds is derived from a study of the African species: so that it is not yet known whether the Asiatic Honey Guides deserve the name of *Indicator*, which is applied to the birds on account of their being "indicators," or "pointers out," of Bees' nests containing honey. Dr. Kirk thus described their habits in the Zambesi district:—"The Honey Guide is found in forests, and often far from water, even during the dry season. On observing a man, it comes fluttering from branch to branch in the neighbouring trees, calling attention. If this be responded to—as the natives do by whistling and starting to their feet—the bird will go in a certain direction, and remain at a little distance, hopping from one tree to another. On being followed, it goes farther; and so it will guide the way to a nest of Bees. When this is reached, it flies about, but no longer guides; and then some knowledge is required to discover the nest, even when pointed out to within a few trees. I have known this bird, if the man, after taking up the direction for a little, then turns away, come back and offer to point out another nest in a different part. But if it does not know of two nests, it will remain behind. The difficulty is that it will



HONEY GUIDE. (*After Keulemans.*)

point to tame Bees in a bark hive as readily as to those in the forest. This is natural, as the Bee is the same; the bark hive—'Musinga,' as it is named—being simply fastened up in a tree, and left for the Bees to come to. The object the bird has in view is clearly the young Bees. It will guide to nests having no honey, and seems equally delighted if the comb containing the grubs be torn out, when it is seen pecking at it." Many of the natives of South Africa believe that the bird will occasionally guide the traveller, through sheer malice, to a Leopard or an Elephant; but on this point there seems some little doubt, to judge from a letter of Mrs. Barber, an accomplished lady and good observer in South Africa:—"What I wrote to you in a former letter is the opinion of many old bee-hunters in this part of the country, who have no faith in the popular belief that leading to the Leopard is done on purpose. My nine brothers, who were all brought up in this country, were all of them great hunters, as well as sportsmen; and during all the years of their experience, while they were living at Tharfield, where Bees' nests were exceedingly plentiful, and where they were constantly in the habit of following these birds, never once did the Honey Guide ever lead them *purposely* to any noxious animal. Many times, in following the bird through dense woods, have they started various kinds of creatures; but if they did not neglect the bird for the purpose of hunting, she would continue her flight towards the Bees' nest, regardless of the startled animals. One of my brothers once, while following a Honey Guide through a dense forest near the Kowie, passed directly through a drove of wild Pigs. They were, of course, more frightened than he was, and rushed about in every direction; but my brother knowing the popular belief, and wishing to test it, took not the slightest notice of the wild Pigs, but passed on, keeping his eye on the bird, who went steadily on her way, until she arrived at the nest she intended to show, regardless of the Pigs. I have other reasons for not believing the story. Why should the Honey Guide waste her time in leading people to Leopards, Jackals, Wolves, and so forth? These creatures are not her natural enemies; she would gain nothing by doing it—no advantage whatever; and I have ever found that in nature there is nothing done in vain, or in an empty, purposeless manner. There is always a reason for the peculiar habits and actions of birds and animals of all kinds; and therefore, why should a bird which does not even rear her own young, and has not the care of a nest, fear or care about these animals? Why should the Honey Guide, unlike all animals, do this thing without any reason for doing it? And again, when the bird has arrived at the nest she intends to show, there is an alteration in the notes of her voice. An old bee-hunter knows this in an instant, and knows when he ought to commence searching for the nest. Now, this alteration never takes place when animals of various kinds are startled in passing through the forest while following the bird. Hence I conclude that she does not intend to show where these creatures are, or the alteration in her voice would take place." Some of the Indicators are not of the same use in guiding to Bees' nests, and are consequently held in less repute. They are all birds of similar coloration, being generally of a dull grey, tinged with yellow or olive, and they vary considerably in size, the larger species, such as *I. major* and *I. sparrmanni*, measuring about eight inches in length; while the smallest species, *I. exilis*, from the Gaboon, does not exceed four inches. Although coming very close to the Cuckoos in the natural classification, the small bill, the thick-set, stout plumage, and the nine primaries in the wing, in addition to their peculiar habits, easily distinguish the Honey Guides as a separate family.

THE FOURTH FAMILY OF THE ZYGODACTYLE PICARIAN BIRDS.

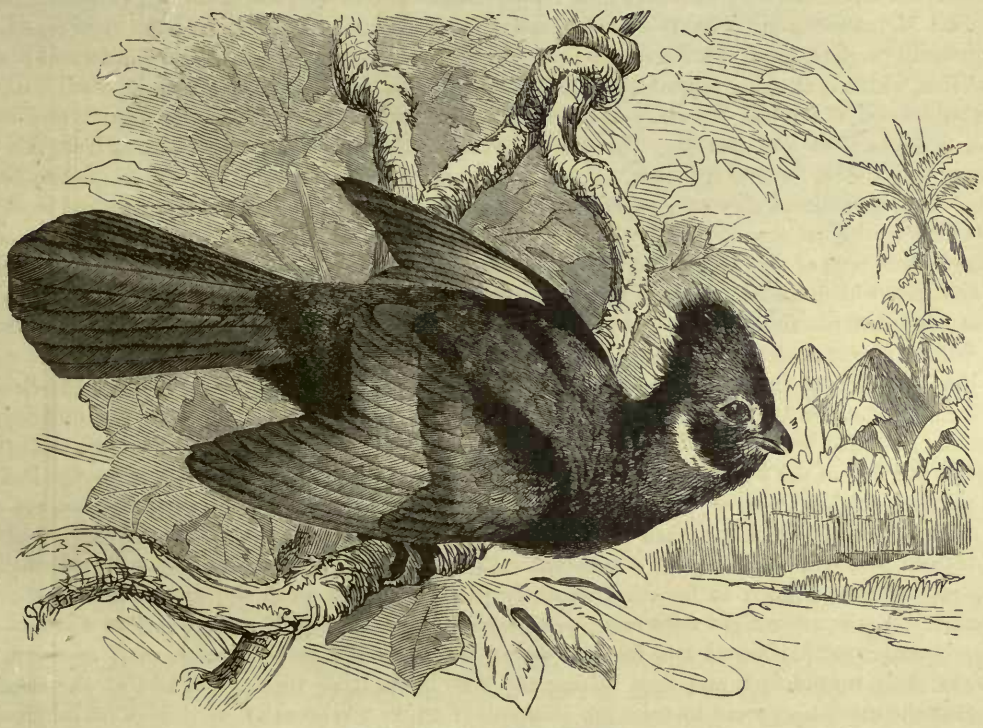
THE PLANTAIN-EATERS (*Musophagidæ*).

These may be called a strictly Ethiopian family of birds, every single member being found in Africa, and nowhere else. They have very much the appearance of game-birds, and are all remarkable for their beautiful crests, which they are able to elevate or depress at will. Although belonging to the Scansorial, or climbing birds, they do not always keep their toes in pairs, but being of a lively disposition they hop continually from bough to bough, and the outer toe is seen as often placed in front with the others as it is directed backwards along with the hind toe. With the exception of the Grey Plantain-eaters, all the other species have beautiful red primaries; and the writer was informed by the late African traveller, Jules Verreaux, that the bird often gets caught in violent showers during the rainy season, when the whole of this brilliant red colour in the wing-feathers gets washed out, and the quills become pinky-white, and after two or three days the colour is renewed, and the wing resumes its former beauty.

THE FIRST SUB-FAMILY OF THE MUSOPHAGIDÆ.—THE MUSOPHAGINÆ, OR TRUE PLANTAIN-EATERS.

THE WHITE-CRESTED PLANTAIN-EATER (*Corythaix musophaga*).

This is perhaps the best known of the whole family of these curious birds, being the commonest species in South Africa, where it is plentiful in the forest districts of the Knysna, and the south coast as far as Natal, and the wooded districts of the Eastern Transvaal. It is known by the name of the Louri, or Lory, and the following brief account of its habits is given by Mr. Layard: *—"The Plantain-eater feeds on fruits, and frequents the highest trees, rarely, if ever, descending to the ground, over which it can, however, travel with great rapidity if brought down by a shot. The motions of



WHITE-CRESTED PLANTAIN-EATER.

this species are very graceful and light, and performed with an ease and rapidity that delight the eye of the beholder. Strange to say, though we inquired carefully, we never could obtain any information respecting the nidification of this beautiful and common bird. Mr. Atmore, however, states that the eggs are white; but this must be from hearsay, as he writes: 'How difficult it is to find these forest birds' nests! The Lories are breeding now, but for the life of me I cannot find a nest. The young ones go in troops, and are delicious eating; the old ones in pairs. We never shoot specimens out of a troop except for the pot.' An old forester told him that the eggs were white, both the latter and the nests being like those of Pigeons. Mr. Rickard says: 'I once found an egg in a bird I shot at East London (January 27th); it was pure white, and the size of a tame Pigeon's.' Mr. Bowker writes: 'I once found a Louri's nest. It was just like a Dove's, built of sticks laid horizontally, and about the size of a large dinner-plate, placed about ten feet from the ground in the centre of a round bush. The old bird flew out as I walked up. I found five young birds in the nest; they were almost full-grown, but their tails rather short and stumpy, crest just showing, but I cannot remember whether the red on the wing was showing or not. On my getting up to the nest they all

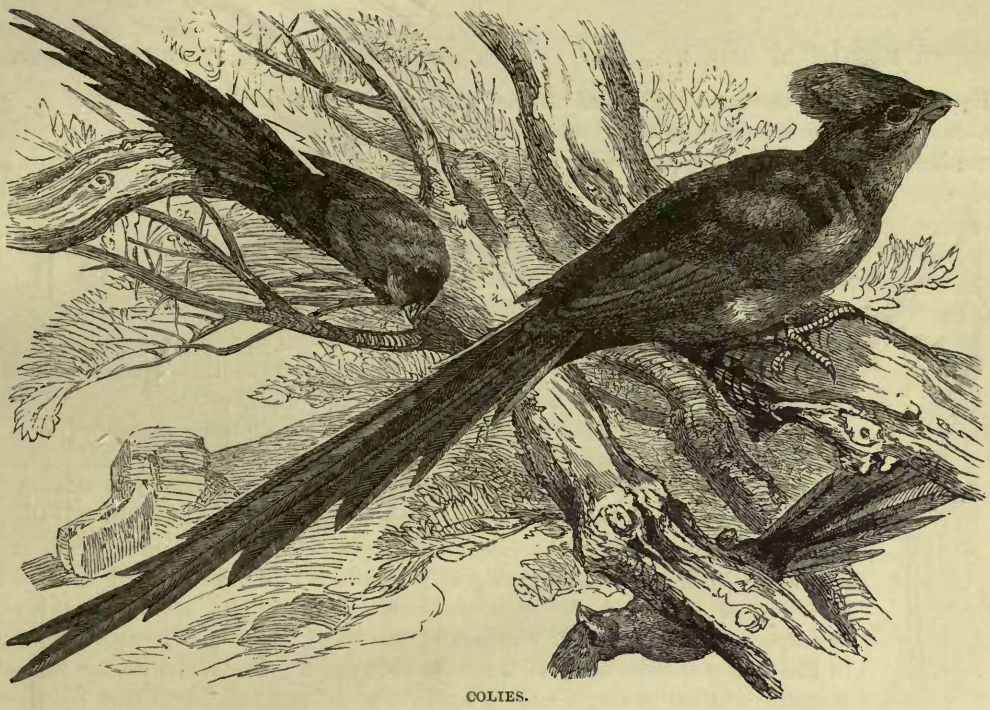
* Sharpe's edition of Layard's "Birds of South Africa," p. 141.

flew out, and were killed by my Dogs before I could come to the rescue. The bush was twenty or thirty yards from the edge of a large forest, and I was rather surprised at this nest, as I had been told they built in hollow trees.'" In size this species is about nineteen inches long; the general colour is green, with a broad white tip to the feathers of the crest, the abdomen and vent are blackish, the quills brilliant carmine.

The false Touracoes, as Dr. Sclater calls them, do not possess the red colouring of the wings, but are for the most part of a uniform grey colour. The best known species is

THE GREY PLANTAIN-EATER (*Schizorhis concolor*).

This is also found in South Africa, but in different districts to the White-crested Plantain-eater. Where the range of the latter ceases that of the present bird begins, and it is found throughout the Matabele country and the Transvaal as far as the Zambesi, and westwards through Damara Land to Angola. Mr. Andersson writes:—"It is partial to localities abounding in large trees; and when prominently perched, with crest erect, it is not unlike a gigantic Coly. It also climbs and flies like the Colies, which it strongly resembles in its general habits. It is usually found in small flocks, and feeds on berries and seeds, especially those of mistletoe and of other parasitical plants, and also on fruits, young shoots, and insects. The Damaras call this species 'Ongoro-oroquena,' from the extraordinary and almost human cry with which it frequently startles the traveller who is passing near its perch. It is sometimes very easy to approach these birds, whilst at other times they are so shy that they will defy the utmost exertions which may be made to obtain them. On January 5th, 1867, I obtained three eggs of this species, of a dull bluish-white colour, at Omapja, from a boy, who told me that the nest which contained them was composed of sticks roughly put together, and situated in a tree at some distance from the ground; and on March 1st I met with a nest in Ondonga placed in a tree, but at no great elevation, which also contained three eggs, much incubated." Dr. Exton, also, who has been through the Matabele country, writes as follows:—"In travelling through the Bechuana country one often comes upon a party of five or six of these birds, hiding from the mid-day heats under the sheltered portions of dense foliage near the centre of a large tree. Whilst yet undisturbed, the crest lies flat on the head, and can only be seen as a tuft projecting from the occiput. But their first act on becoming aware of an intruder is to run along the branches, either to the summit of the tree or to the extremity of a branch commanding a good look-out, where, with crest fully erected and well thrown forward, they keep up a constant reiteration of their note. If but little alarmed they move rapidly from branch to branch, frequently jerking up the crest, and assuming an attitude of attention. Again, after flight from one tree to another, on alighting, they first rest on a branch, with the body somewhat horizontal and the tail drawn nearly to the perpendicular, as if assuring themselves of their equilibrium, and then raising the body, elongating their neck, and at the same time elevating the crest, they seem to take an observation as to the security of their new position. So much is this a habit of the bird, that during the conversational difficulties of my earlier intercourse with the Bechuanas, when inquiring for the nest of Schizorhis (the native name of which is 'Ma-quaai'), as soon as it dawned upon the mind of a native what bird I meant he has imitated its note, accompanied by a sudden jerking up of the hand, with his fingers extended to the utmost, as if at the same time to mimic the elevation of the crest. Dr. Sclater mentions that 'Mr. J. J. Monteiro, speaking of the Grey False Touraco (*S. concolor*), as observed in Benguella, expressly states that the crest-feathers are always carried erect.' In my own experience, the observation of Schizorhis was an every-day occurrence; and, as I have stated, when undisturbed (also when in flight) very little of the crest is to be seen, but is invariably carried erect on the least alarm. I may here mention a peculiar scream of *S. concolor*. I was one day walking along a low ridge of rocks, from which I flushed an Owl—the common *Bubo maculosus*—that flew to some distance to a clump of trees. Presently I heard an agonised scream, such as is made by a young Antelope when seized by a Dog; and so exact a repetition of the sound was it that even my Dogs were deceived by it, and rushed off in the direction whence it came. I also sent a Kaffir boy, and presently followed myself, when I discovered it was the frightful scream of *Schizorhis*, of which a party were collected round the Owl I had previously disturbed, and whose presence appeared to be the exciting cause. At a later period I had a second opportunity of verifying this observation."



COLIES.

THE SECOND SUB-FAMILY OF THE MUSOPHAGIDÆ.—THE COLIINÆ, OR COLIES.

Like the foregoing sub-family, the Colies are confined to Africa. They have decided affinities with the true Plantain-eaters, but are distinguished at a glance by their long tails, the feathers of which are much pointed, and become smaller and narrower towards the outside of the tail. They are most dexterous climbers, as was well seen in the captive specimens of the Chestnut-backed Coly, which were brought by Cameron from Angola, and lived for some time in the London Zoological Gardens.

THE WHITE-BACKED COLY (*Colius capensis*).

The Colies are known in the Cape Colony by the name of *Muisvogel*, or Mouse-bird, and they are not uncommon, ranging about in small families of from six to eight individuals. Mr. Layard says that they fly with a rapid, though laboured flight, generally at a lower level than the object at which they aim, and on nearing the latter they rise upwards with a sudden, abrupt curve. They creep among the branches like Parrots, and hang suspended head downwards, without inconvenience; and it is said that they invariably sleep in this position, many of them congregated in a ball. The nest was found by Mr. Andersson in Damara Land, between September and December. It was placed in a small bush, and was composed externally of grass and twigs, lined internally with softer grass, and the eggs were dull white, and, according to his observations, always three in number. Mr. Andersson states that the bird "is gregarious in its habits, being found in flocks by day, and also when roosting at night. Its flight is short and feeble, seldom extending beyond the nearest bush or tree, on reaching which it usually perches on one of the lower branches, and then gradually glides and creeps upwards through the foliage, using both bill and feet for that purpose. It is essentially a fruit-eating bird, but I believe when hard pressed for its regular food it does not despise insects and the young shoots of plants. Its flesh is palatable." The Colies as a rule are dull-coloured brown birds, but they have a long crest. The present species is perhaps the handsomest, being ash-coloured, and having the lower back and rump purple glossed with red, while a white line, bordered on each side by a broad black one, extends from beneath the shoulders to the rump. The bill is bluish-white, and the feet bright red. The length of the bird is thirteen or fourteen inches.

THE FIFTH FAMILY OF THE ZYGODACTYLE PICARIAN BIRDS.—THE WOODPECKERS (*Picidæ*).

These are perhaps the most typical of all the yoke-footed or climbing birds, as they are most expert climbers, being aided in the latter operation not only by their long toes, which are arranged as usual in this order in pairs, but by their stiffened tail, which enables them to climb with great rapidity up the perpendicular trunks of trees. If they wish to descend a little way they do not turn and come down head-foremost, as a Nuthatch would do, but they let themselves down by a few jerks, still keeping an oblique position, with the tail downwards. The bill in almost every member of the family is wedge-shaped, and very powerful, and with this organ a Woodpecker taps vigorously at the bark, which he sometimes also prises off to get at the grubs or insects underneath. These latter, as they endeavour to escape, have little chance against the intruder, who, in addition to the stout bill which discloses their place of concealment, possesses a peculiar tongue, which is capable of being protruded to a long distance, is furnished with minute barbs at the end, and is covered with a glutinous fluid from which the insects are unable to free themselves. The Woodpeckers nearly all procure their food in the above manner, but occasionally frequent the ground, and the Green Woodpecker (*Gecinus* * *viridis*) commits great ravages among ant-hills. The resting-place is generally a hole excavated by the bird itself in a hollow tree, and the eggs are white. Among the most aberrant of the Woodpecker family are the Wrynecks (*Iijnx* †), of which one species is well known in England under the name of the "Cuckoo's mate." The Wrynecks are all birds of beautiful mottled plumage, and do not have a stiffened tail like a true Woodpecker. They are found in Europe, in India, North-Eastern and Southern Africa. Woodpeckers, on the other hand, are extremely plentiful in the New World, and are distributed all over Africa, Europe, and Asia, but are not found in the Australian region, no Woodpecker occurring beyond the Island of Celebes in the Moluccas.

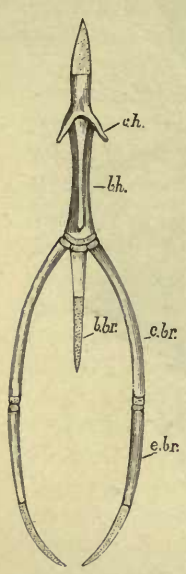


Fig. 1.—"HYOID" BONE OF ADULT FOWL. (*After W. K. Parker.*)

(*ch*) Cerato-hyals; (*bh*) the so-called Basi-hyal; (*b.br*) Basi-branchial, or Uro-hyal; (*c.br*, *e.br*) together form the thyro-hyal.

One great peculiarity in the anatomy of the Woodpeckers is the structure of the tongue, and its relation to the hyoid bone and its horns, or cornua. (For a description of this part in the Mammalia, see Vol. I., p. 168.) In Birds the hyoid bone is a much more complex structure than in the Mammalia. Besides forming the basis of the otherwise mainly muscular substance of the tongue, it is continued backwards in most birds as a double chain of bones, each pair of which bears a separate name significant of its importance; and the whole is apparently quite distinct from the skull above and from the larynx below. Its composition in the common fowl is best rendered intelligible by reference to the accompanying woodcut (Fig. 1). It represents the entire hyoid apparatus divested of all muscular and other surrounding tissues. The upper part of the figure is that nearest to the tip of the tongue, and the references to the lettering become clear in the course of the subsequent description.

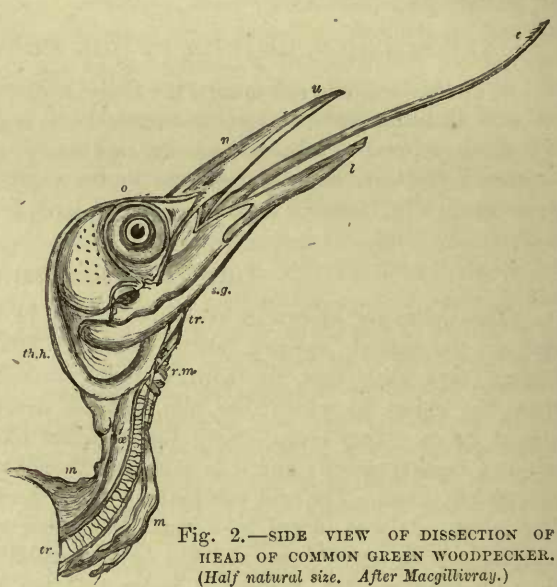


Fig. 2.—SIDE VIEW OF DISSECTION OF HEAD OF COMMON GREEN WOODPECKER. (*Half natural size. After Macgillivray.*)

(*u*, *l*) Upper and Lower Mandibles; (*t*) Barbed Tip of Tongue; (*th.h.*) Thyro-hyal Bone of Right Side, with its Muscle and Sheath; (*o*) Right Orbit; (*n*) Right Nostril; (*s.g.*) Right Salivary Gland; (*m*, *m*) Muscles of Neck; (*œ*) Œsophagus; (*tr*) Trachea; (*r.m.*) Retractor Muscles of Tongue wound round Trachea.

Another woodcut (Fig. 2) shows a side view of a dissection of the head of the common Green Wood-

* γῆ, earth, and κινέω, I shake; *viridis*, green.

† The classical Greek name, from its double note sounding like the exclamation ἰύ, hence the verb ἰύζω, I cry out.

pecker (*Gecinus viridis*), and a reference to the explanation of the lettering on it will give a general idea of the whole.

The tip of the tongue (*t*) is a slender, flattened, horny point, bearing on its sides and upper surface a number of very delicate bristles, or prickles, directed backwards, an arrangement eminently useful to the bird for enabling it to extract its insect food from the recesses to which its beak, by reason of its size and hardness, could not readily, nor with sufficient quickness, gain access. This tip is further rendered a more efficient instrument for this purpose by its being constantly moistened by a very viscid saliva secreted by two particularly large salivary glands (Figs. 2, 3, and 4, *s.g.*); and it was long ago remarked by Sir Charles Bell, in his essay on "The Hand" (Bridgewater Treatise, 1837), that the same muscles that effected the protrusion of the tongue exerted a simultaneous pressure upon these glands, so that the first result of the muscular contraction is to lubricate the tongue, while the rest of its force is spent in shooting it out with marvellous rapidity.

Behind this barbed and horny tip, the tongue is a slender worm-like body, of which the core is the anterior prolongation of the hyoid bone. The fore-part of this core, more like a bristle than a bone, is known to anatomists as the "glosso-hyal," and it is immediately succeeded posteriorly by the "cerato-hyal."* Behind this is the "basi-hyal" (Fig. 1, *b.h.*), the last bone to enter into the formation of the tongue proper. From this basi-hyal springs the pair of bones —the "thyro-hyals"—which attain the remarkable degree of development for which the birds now under consideration are distinguished. From each side of the hinder portion, then, of this basi-hyal bone diverge these important "thyro-hyals" (Fig. 1, *c.br.*, *e.br.*). They, in the Woodpeckers (compare Fig. 3, *th.h.*), extend outwards and backwards to pass one on each side of the neck until they curl upwards and forwards, converging to meet one another on the upper part of the back of the head; thence they run along together, ploughing themselves a furrow in the skull-top till they reach almost to the right nostril. Each of these curved and highly elastic bones is surrounded by a delicate sheath, whose inner surface is kept constantly moist and lubricated by its own secretion; and this sheath is attached to the bone of the skull at its junction with the upper mandible, as is shown in the accompanying woodcut (Fig. 3, *i*).

Fig. 3. — UPPER VIEW OF SKULL OF GREEN WOODPECKER.

(*After Macgillivray.*,

(*th.h.*,*th.h.*) Thyro-hyal Bones; (*i*) Point of their Insertion; (*s.g.*, *s.g.*) Salivary Glands.

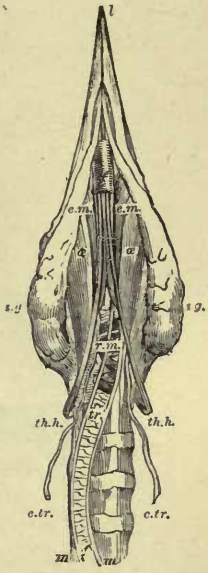


Fig. 4.—DISSECTION OF HEAD OF GREEN WOODPECKER VIEWED FROM BELOW.

(*After Macgillivray.*)

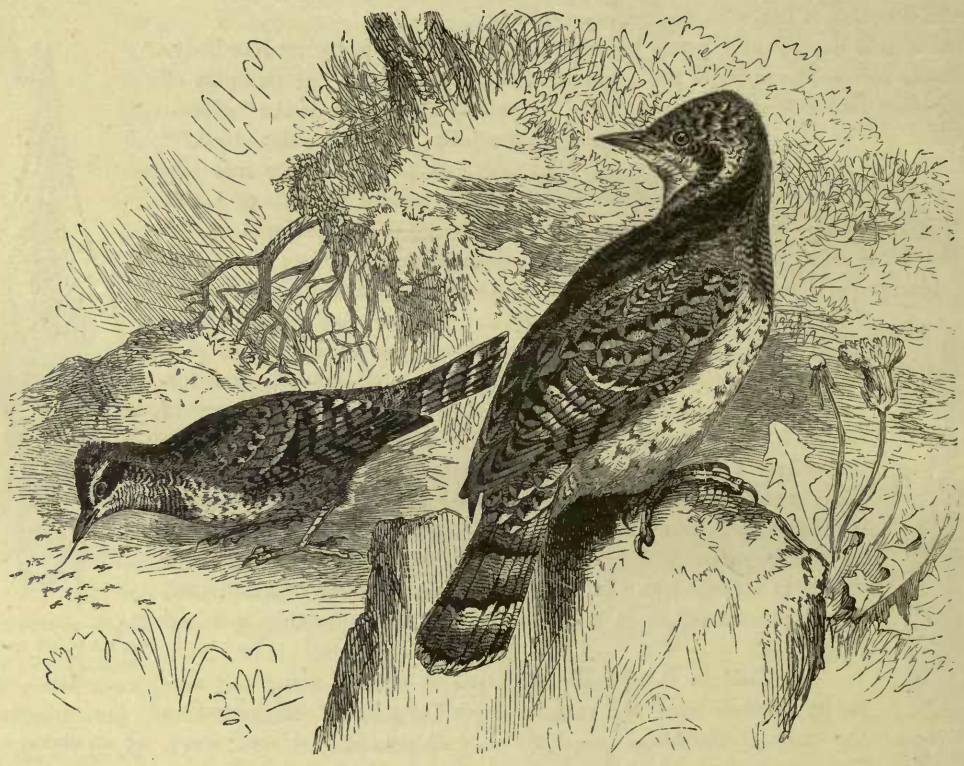
(*l*) Lower Mandible; (*f*) Base of Tongue; (*th.h.*,*th.h.*) Thyro-hyals; (*s.g.*, *s.g.*) Salivary Glands; (*m*, *m*) Muscles of Neck; (*α*, *α*) Œsophagus; (*tr*) Trachea; (*e.m.*, *e.m.*) Extrusor Muscles, which thrust out the Tongue; (*r.m.*) Retractor Muscles of Tongue wound round Trachea; (*c.tr.*, *c.tr.*) Cleido-tracheal Muscles, binding Trachea to Shoulder-girdle.

Enclosed in the sheath here spoken of, and along the concavity of each bone, is a muscle which has a fixed attachment to the crura of the lower mandible on each side (Fig. 4, *e.m.*, *e.m.*). The contraction of this muscle shoots the tongue out in two different ways. In the Green Woodpecker the extremities of the thyro-hyal bones are themselves attached to the mandible, while the curvature of the bones makes a loop that hangs low down on each side of the neck (see Fig. 2, *th.h.*). As the muscle is shortened this loop is raised up, and the free tip of the tongue is consequently projected; and since the muscle is on the inner, or concave, side of the curve, a very small shortening on its part makes a great addition to the apparent length of the tongue. Sir Charles Bell elucidates this action by comparing the great effect on the curve of a fishing-rod's flexible top that a small tightening of the line has. But while this is the case in many species, there are others in which the sheath alone is attached to the bones of the forehead, and the bones themselves slide along inside together with the contracting fibres of the muscle, thus producing the same result as was obtained in the other case by the loops hanging low down in the neck.

* Compare Fig. 1, *ch.*; this bone usually exists in a paired condition, but in Woodpeckers and some other birds it appears single by the confluence of its members In many birds the "basi-hyal" is succeeded by the "uro-hyal" (Fig. 1, *b. br.*), a bone altogether absent whenever the tongue is capable of extraordinary protrusion.

The tongue, whose length is thus so extraordinarily increased, is drawn back to its original position within the bill by another pair of muscles, one on each side, which are attached to the basi-hyal. These take their origin from the trachea, around which (as shown in Figs. 2 and 4, *r.m.*), in many species, they are curiously wound in their course. And, since the bones are at the point of their greatest curvature when at rest, it is obvious that this action of withdrawal is materially assisted by the elasticity of the prolongations of the hyoid bones themselves; for it is a well-known law that Nature never lets power run to waste, but always utilises forces of mere elasticity or rigidity when by their means the expenditure of nervous energy and muscular contractility can be saved.

It may be observed that this curious development of the bones of the tongue is not confined to the Woodpeckers; in the Sun Birds (*Nectariniidæ*) of the Old World, and the Humming-Birds



WRYNECK.

(*Trochilidæ*) of the New, this same adaptation of means to ends obtains. Even in the Picidæ themselves many variations have been noticed, in addition to those above alluded to; for instance, in the Yellow-billed Woodpecker (*Sphyrapicus* varius*) of North America the horns of the hyoid do not reach so far as the eye, so that the tongue, with its bushy tip in this case, is only extensible in a very slight degree; while in the Hairy Woodpecker (*Picus villosus*) the thyro-hyals curve spirally over the right orbit so as to reach entirely around the eye, to be inserted at its lower posterior margin.

Considerable difference of opinion exists as to the damage done by Woodpeckers in tapping sound trees, and many a poor bird pays the penalty of his life for his supposed destructive propensities. Mr. Waterton argues strongly on the side of the bird, and alleges that only rotten and unsound trees are attacked for the sake of a nesting habitation, or for the purpose of getting insects; but that this is not always the case was proved by the writer himself in the spring of 1878, when a boy was sent up to a hole in a beech-tree in Avington Park, in Hampshire. The tree was still

* σφῦρα, a hammer; *picus*, a woodpecker.

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GREAT BLACK WOODPECKER AND GREAT SPOTTED WOODPECKER.

perfectly sound, so sound, indeed, that the bird had evidently given up the idea of inhabiting it for that year, and had betaken himself elsewhere, after having excavated a round hole to the depth of two or three inches. In the same tree, a little lower down, was a similar hole, evidently made the previous year, when the bird had "tapped" the tree, and it was clear that he had returned again in the succeeding season, and had tried a little higher up in the trunk, to see if there were any chance of procuring a domicile. This proceeding must have injured the tree, and was the work of a Green Woodpecker, or Yaffle, whose laughing note was heard from another quarter of the park, even as the above examination was being conducted. In this part of Hampshire, though the bird is not persecuted by the owner of Avington, Mr. Edward Shelley, or by his keepers, the Green Woodpecker is rare; but in certain parts of Huntingdonshire the writer can remember to have found it

GREEN WOODPECKER.

very plentiful in his school-days, and it was a never-failing object in a country walk, flitting from tree to tree in front of the observer, and always keeping a sharp look-out from the opposite side of the trunk on which he settled. This species appears in old pieces of poetry under the various names of Yaffle, Woodwele, or Woodwale, Whetile, and it is in some places called "Hewhole," Woodhacker, &c.*:—

"The Skylark in ecstasy sang from a cloud,
And Chanticleer crowed, and the Yaffil laughed loud."
The Peacock at Home.

The Woodwele sang, and would not cease,
Sitting upon the spray;
So loud he wakened Robin Hood
In the greenwood where he lay."
Ritson's Edition of *Robin Hood*, vol. i., p. 115.

* Yarrell, "British Birds," vol. ii., p. 137.

"There the Jay and the Throstell
The Mavis menyd in her song,
The Woodwale fard or beryd as a bell
That wode about me rung."

True Thomas.

Some Woodpeckers seem to make storehouses against the winter, by pecking holes in a tree, and an interesting example of a piece of bark, in which a Red-headed Woodpecker (*Melanerpes formicivorus*)* had placed a store of acorns, is to be seen in the British Museum.

Another British species, the Lesser Spotted Woodpecker (*Picus*† *minor*), is a bird of different habits, frequenting fruit-gardens in the autumn, and doing very little damage to trees in the nesting season. It generally selects the rotten branch of an old poplar-tree, and hollows out a hole in so perilous a situation that it is difficult to climb to, and, indeed, the whole bough is often brought down by the first gale in the ensuing winter. Here its small wedge-shaped bill speedily makes an excavation, and at some little distance down in the hollow interior it lays its glossy white eggs on the touchwood and decaying wood. Both sexes assist in the preparation of the nest; and in mild winters they sometimes begin with the commencement of the year to look out for their future home. The selection of this appears to be a matter of no small anxiety, for several trees are examined in turn, and often at long distances apart. The birds at the time of incubation keep up a continual signalling one to the other, which is produced by a rapid whirring noise caused by tapping on the thinner branches of the dead trees. This call-note, if it may be called such, is generally heard in the early morning, and ceases as soon as the nesting operations have finally commenced. Besides this note, they have also one like the "laugh" of the Green Woodpecker, but, of course, much reduced in accordance with the difference in the size of the two birds. The little Spotted Woodpecker may often be seen hanging on to, and climbing round, the slender twigs of the outer branches of a tree, and looks much like a Creeper or a Nuthatch, which it does not greatly exceed in dimensions.

THE SIXTH FAMILY OF THE ZYGODACTYLE PICARIAN BIRDS.

THE TOUCANS (*Rhamphastidæ*).‡

The Toucans, with their clumsy bills, have much the aspect of Hornbills, which they may be said to represent in South America, to which continent they are entirely confined, but by this time the student knows that they have really little to do with each other, beyond a certain outward similarity, as the Toucans belong to the Scansorial, the Hornbills to the Fissirostral, section of the *Picariæ*. It is not possible to give a long account of the habits of individual species of Toucans, and a general sketch of their manners and customs is extracted from the monograph of the Toucans written by Mr. John Gould.§ To him the late Prince Maximilian, of Neuwied, an excellent observer, during his travels in South America writes:—"The *Rhamphastidæ* are very common in all parts of the extensive forests of the Brazils, and are killed in great numbers at the cooler portion of the year, for the purposes of the table. To the stranger they are of even greater interest than to the natives, from their remarkable form, and from the rich and strongly-contrasted style of their colouring, their black or green bodies being adorned with markings of the most brilliant hues—red, orange, blue and white—the naked parts of the body dyed with brilliant colours, the legs blue or green, the irides blue, yellow, &c., and the large bill of a different colour in every species, and in many instances very gaily marked. The colouring of the soft parts is, however, so evanescent, that, to determine the species with accuracy, they must be depicted during life or immediately after the birds are killed. Common as these birds are in their native wilds, it is exceedingly difficult to detect their breeding-places; it is certain that they deposit their eggs in the hollow limbs and holes of the colossal trees so abundant in the tropical forests, but I never was so fortunate as to discover them. The stomachs of the specimens I examined contained nothing but the remains of fruits, principally of the softer kinds, for which, indeed, they have such a liking that they resort in great numbers to the plantations in the vicinity of their native haunts, and commit sad havoc among their favourite delicacies. I was informed that they frequently steal and eat young birds, but no instance of their doing so came under my own observation, and I never

* μέλας, black; ἕρπω, I creep; *formicivorus*, ant-eating. † Linnæus. A proper name. ‡ From ῥάμφος, a bill.
§ "Monograph of the *Rhamphastidæ*, or Family of Toucans," by John Gould, F.R.S. Introduction.

detected the remains of animal food in their stomachs. Mr. Waterton's opinion agrees with mine, that they feed solely upon fruits; but Azara, among others, states that they also feed upon animal substances. The specimens we saw in a state of domestication were very voracious and perfectly omnivorous, but they seem to be purely frugivorous in a state of nature, a fact which was, indeed, confirmed by the Brazilian natives whom we questioned on the subject. In their manners the *Rhamphastidæ* offer some resemblance to the Crows, and especially to the Magpies; like them they are very troublesome to the birds of prey, particularly to the Owls, whom they surround and annoy by making a great noise, all the while jerking their tails upwards and downwards. The flight of these birds is easy and graceful, and they sweep with facility over the loftiest trees of their native forests, their strangely-developed bills, contrary to expectation, being no encumbrance to them. The voice of the Toucans is short and unmelodious, and is somewhat different in every species. The feathers are used by the Indians for personal decoration, especially the yellow breasts of the birds, which they affix to their heads on each side near the temple, and also to the ends of their bows."

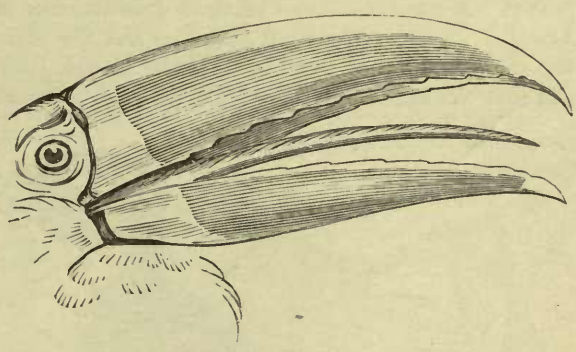
Mr. Waterton, in one of his Essays, has the following remarks:—"There are three species of Toucan in Demerara, and three diminutives, which may be called Toucanets. The largest of the former frequents the mangrove-trees on the sea-coast. It is never seen in the interior until you reach Macoushia, where it is found in the neighbourhood of the river Tacatou; the other two species are very common. They feed entirely on the fruits of the forest, and, though of the Pie kind, never kill the young of other birds or eat carrion. The larger is called *Bouradi* by the Indians (which means *nose*), the other *Scirou*. They seem partial to each other's company, and often resort to the same feeding tree, and retire to the same shady noon-day retreat. They are very noisy in rainy weather at all hours of the day, and in fair weather at morn and eve. The sound the *Bouradi* makes is like the clear yelping of a puppy-dog, and you fancy he says '*Pia-po-o-co,*' and thus the South American Spaniards call him *Piapoco*. All the Toucanets feed on the same trees on which the Toucan feeds, and every species of this family of enormous bill lays its eggs in the hollow trees. They are social, but not gregarious. You may sometimes see eight or ten in company, and from this you may suppose they are gregarious, but upon a closer examination you find it is only a dinner party, which breaks up and disperses towards roosting-time. You will be at a loss to conjecture for what end Nature has overloaded the head of this bird with such an enormous bill. It cannot be for the offensive, as it has no need to wage war with any of the tribes of animated nature, for its food is fruits and seed, and those are in superabundance throughout the whole year in the regions where the Toucan is found. It cannot be for the defensive, as the Toucan is preyed upon by no bird in South America, and, were it obliged to be at war, the texture of the bill is ill-adapted to give or receive blows, as you will see by dissecting it. The flight of the Toucan is by jerks. In the action of flying it seems incommoded by this huge, disproportionate feature, and the head seems as if bowed down to the earth by it against its will. If the extraordinary size and form of the bill expose the Toucan to ridicule, its colours make it amends. Were a specimen of each species of Toucan presented to you, you would pronounce the bill of the *Bouradi* the most rich and beautiful one. It is worthy of remark that all these brilliant colours of the bill are to be found in the plumage of the body and the bare skin around the eye." Space will not permit of a long extract from the works of d'Azara (the only field naturalist of any fame that Portugal has yet produced), but a few notes of this traveller, made in Paraguay, differ from the foregoing accounts, and show that in the southern portion of their range the habits of some of the Toucans vary to a great extent. So voracious does d'Azara consider them, that on this account he places them among the birds of prey, and writes:—"The Toucans, contrary to all appearances, destroy a great number of birds, and, on account of their long and strong beak, are respected and feared by all species. They attack and drive them from their nests, and in their very presence eat their eggs and young; these they draw from the holes with the long beak, or throw down nest and all together. It is credibly reported that the Toucans do not even respect the eggs or young of the 'Aras' (Macaws) and Caracaras, and if the fledglings are too large or too strong to be lifted from the nest, they dash them to the ground, as if it were their nature not only to devour, but to uselessly destroy. The bird, in flying, presents the point of his bill against the wind, so that it does not offer more resistance than that of other birds in which the head and superficies are equal in extent; besides which, the conformation and specific lightness of this long beak cannot impede flight, because the highest points

of the bird being the bill itself and the anterior portion of the body, they form no obstacle, the wind first taking effect upon the point of the bill. When in a state of repose, the Toucan carries its bill rather more elevated than a horizontal line that would pass through the eyes, and when closely looked at, it looks like a false bill, because its base exceeds the breadth of the head, which presents the appearance of being enclosed in a case. In addition to these singularities, the nostrils are placed behind the aforesaid base. The tongue is very narrow and of an equal thickness throughout. It is entirely osseous, and resembles somewhat a feather two lines in width, furnished with an osseous fringe, which is directed from behind forwards, so that the tongue, stiff and unyielding, takes no part in the direction of the food nor in the formation of the note, which, in the first two Paraguayan species, is confined to the single syllable '*rae*.' The mandibles are very distinctly dentated at their edges, these dentations not corresponding at all above and below, nor are they even relatively symmetrical. The beak itself is a thin osseous sheath, filled with a number of empty cellules. The eye is large, and surrounded by a triangular naked space, puffed up, and very pretty. The foot is very short and stout, and covered nearly to the heel with long scales, harsh to the touch. The outer toe, as well before as behind, is the longest. The claws are much flattened and curved, as in the Woodpeckers. The tail is composed of ten feathers. The Toucan flies at a moderate height, and in a straight horizontal line, flapping its wings occasionally with some noise. The flight is quicker than the smallness of the wings would lead one to believe. It perches towards the top of the highest trees, and though unable to climb after the manner of Woodpeckers, it still progresses with speed, hopping from branch to branch. It pays great attention to all that takes place in its vicinity, advancing with fear and diffidence, like the 'Uruca' and the 'Acahes.' There is no perceptible difference between the two sexes, nor do I believe that the species exists towards the south beyond 28°, nor that it drinks. It rarely settles on the ground. The Toucan hops obliquely and very awkwardly, with the legs separated about a hand's breadth. When it takes young birds from the nest, pieces of meat or fruit, it throws them in the air, as a juggler his balls, and by a quick movement of the beak repeats this action until the food is in a favourable position for being swallowed, and then by another movement gulps it down its large throat. If the

TOUCAN.

mouthful be larger than the orifice of the gullet, the Toucan abandons it without seeking to divide it."

Mr. Bates, in his "Naturalist on the River Amazon," makes some further allusions to the Toucans and their bill, which will be found well worth the reading. He also gives the following history of a tame bird (Vol. ii., p. 341):—



BILL OF TOUCAN.

"One day, whilst walking along the principal pathway in the woods near Ega, I saw one of these Toucans seated gravely on a low branch close to the road, and had no difficulty in seizing it with my hand. It turned out to be a runaway pet bird; no one, however, came to own it, although I kept it in my house for several months. The bird was in a half-starved and sickly condition, but after a few days of good living it recovered health and spirits, and became one of the most amusing pets imaginable. Many excellent accounts of the habits of tame Toucans have been published, and therefore I need not describe them in detail; but I do not recollect to have seen any notice of their intelligence and confiding disposition under domestication, in which qualities my pet seemed to be almost equal to Parrots. I allowed Tocáno to go free about the house, contrary to my usual practice with pet animals. He never, however, mounted my working-table after a smart correction, which he received the first time he did so. He used to sleep on the top of a box in a corner of the room, in the usual position of these birds—namely, with the long tail laid right over on the back and the beak thrust underneath the wing. He ate of everything that we eat (beef, turtle, fish, farina, fruit), and was a constant attendant at our table—a cloth spread on a mat. His appetite was most ravenous, and his powers of digestion quite wonderful. He got to know the meal-hours to a nicety, and we found it very difficult, after the first week or two, to keep him away from the dining-room, where he had become very impudent and troublesome. We tried to shut him out by enclosing him in the back yard, which was separated by a high fence from the street on which our front door opened; but he used to climb the fence and hop round by a long circuit to the dining-room, making his appearance with the greatest punctuality as the meal was placed on the table. He acquired the habit afterwards of rambling about the street near our house, and one day he was stolen, so we gave him up for lost. But two days afterwards he stepped through the open doorway at dinner-hour, with his old gait, and sly, magpie-like expression, having escaped from the house where he had been guarded by the person who had stolen him, which was situated at the farther end of the village."

THE SEVENTH FAMILY OF THE ZYGODACTYLE PICARIAN BIRDS.

THE BARBETS (*Capitonidæ*).*

These are climbing birds of somewhat brilliant coloration, distributed over the tropical portions of both hemispheres, but absent in Europe, Northern Asia, Australia, and the Moluccas southwards from the Sunda Islands. "Though strictly arboreal in their habits," write Messrs. Marshall, in their exhaustive work on the family,† "and living only in forest districts or open countries interspersed with groves of trees, they are neither shy nor difficult to approach. When the districts in which they are found happen to be at all thickly populated, the Barbets show no disposition to retreat to more secluded quarters, but take up their abode in gardens, and frequently breed in trees close to the houses. They usually keep to the tops of the trees, but may occasionally be seen creeping among the branches of small bushes and underwood. Their food is fruit, seeds, buds, and occasionally insects; these latter are very seldom resorted to in Asia, more frequently in Africa, and with some American species they form the staple food. They are not gregarious, though a great number may sometimes

* From *Capito*, the principal genus: a proper name.

† "A Monograph of the Capitonidæ, or Scansorial Barbets," by C. H. T. Marshall and G. F. L. Marshall (1871).

be seen together in a fig-tree at the fruit season. They live in pairs during the breeding season, which is in the spring, and commence moulting in September. They rarely, if ever, descend to the ground, and appear to move from tree to tree only when compelled to do so in search of food, or when disturbed by an intruder. Their flight is powerful, but heavy and undulating, like that of a Woodpecker. A curious instance of their disinclination to travel is seen in the fact of the Himalayan Lineated Barbet (*Megalæma hodgsoni*) and the Hoary Jungle Barbet (*M. caniceps*) never crossing the narrow valley of the Deyra Doon, though both are abundant in their respective boundaries; also that the Blue-faced Barbet (*M. asiatica*) is confined to the valley of the Jumna, in the district between Mussooree and Simla, though there are many other valleys apparently equally suitable. When not in pursuit of food, the Barbets sit motionless among the foliage near the tops of the trees, and exhibit none of that vivacity which is so marked a characteristic of the Passerine birds, amongst which they have been sometimes erroneously classed. Their voice is loud and ringing, consisting almost always of one, two, or three syllables, given out with extraordinary power, and may be heard at midday or on a moonlight night when all other sounds are hushed. Some of the American species have, in common with the Toucans, the habit of jerking their tail up over their back when they utter their call. The male and female sometimes keep up what appears to be a 'calling-match' for about ten minutes, and then suddenly cease. As far as is known, they all build in holes of trees, which they make for themselves in soft or decayed branches. No lining is needed for the nest, a few of the broken chips being left at the bottom of a hole. The entrance is circular and neatly bevelled, resembling that of a Woodpecker. The hole is generally about eight or ten inches deep, varying, of course, with the size of the bird. They lay three or four shining white eggs, with rather thin shells, and rather elongated, blunt, oval in shape, both ends being nearly similar. They are laid in the latter end of April and beginning of May in Northern India. Barbets are occasionally caged, but they are very seldom brought to England, and do not bear confinement very well; consequently, little is known of them in this country, except to ornithologists. An interesting account of one of them (*Megalæma zeylanica*) in captivity, by Mr. Layard, will be found quoted below. Their plumage, though very brilliant, is tasteless and too gaudy, and their shape is heavy and ugly, which will account for their skins not yet having been promoted to the positions with which pretty birds' feathers are generally associated in the minds of the non-ornithological public." Mr. Layard's account is as follows:—"The Brown-headed Barbet is common in Ceylon, and universally distributed. It feeds on fruits and berries of all kinds, which it swallows entire. It does not, that I know of, devour

PEARL-SPOTTED BARBET.

small birds when in a state of nature, but one kept in a large aviary at Colombo destroyed all the little *Amadinæ* placed with it. Not content with snapping them up when within his reach, he would lie in wait for them behind a thick bush or the feeding-trough, pounce upon them unawares, and, after beating them a little on the ground or perch, swallow them whole. When this cannibal came into my possession he was confined in a smaller cage than that in which he had at first been secured. This seemed to displease him, and he went to work to find some means of escape. He narrowly examined every side and corner to discover a weak spot, and having detected one, applied himself vigorously to bore a hole through it, as a Woodpecker would have done. Grasping the bars with his feet, he swung himself round, bringing his whole weight to bear upon his bill, which he used as a pickaxe, till the house resounded with his rapid and well-aimed blows. On being checked from exercising his ingenuity in this manner, he became sulky, and refused to eat or offer his call of recognition when I approached him. In a day or two, however, he apparently thought better of the matter, resumed his labours upon another spot, and fed as voraciously as ever, devouring huge slices of bananas, jungle fruits, the bodies of any small birds I skinned, &c."

THE SECOND ORDER.—PICARIAN BIRDS. SUB-ORDER II.—FISSIROSTRES.

CHAPTER IX.

THE JACAMARS, PUFF BIRDS, KINGFISHERS, HORNBILLS, AND HOOPOES.

THE JACAMARS—THE PUFF BIRDS—THE KINGFISHERS—Characters—THE COMMON KINGFISHER—Distribution—Its Cry—Habits—After its Prey—Its own Nest-builder—Mr. Rowley's Note on the Subject—Nest in the British Museum—Superstitions concerning the Kingfisher—Colour—Various Species—CRESTED KINGFISHER—PIED KINGFISHER—Dr. Von Heuglin's Account of its Habits—New World Representatives—OMNIVOROUS KINGFISHERS—THE AUSTRALIAN CINNAMON-BREASTED KINGFISHER—Macgillivray's Account of its Habits—THE LAUGHING JACKASS of Australia—Its Discordant Laugh—The "Bushman's Clock"—Colour—Habits—THE HORNBILLS—Character—Their Heavy Flight—Noise produced when on the Wing—Food—Extraordinary Habit of Imprisoning the Female—Native Testimony—Exception—Fed by the Male Bird—Dr. Livingstone's Observations on the point, and Mr. Bartlett's Remarks—Strange Gizzard Sacs—Dr. Murie's Remarks—Mr. Wallace's Description of the Habits of the Hornbills—Capture of a Young One in Sumatra—THE GROUND HORNBILLS—South African Species—Kaffir Superstition regarding it—Habits—Mr. Ayres' Account of the Natal Species—How it Kills Snakes—The Call—Habits—Mr. Monteiro's Description of the Angola Form—Turkey-like Manner—Wariness—Food—THE HOOPOES—Appearance—Distribution—THE COMMON HOOPOE—Habits—The Name—How does it Produce its Note?—THE WOOD HOOPOES—Habits.

THE FIRST FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.

THE JACAMARS (*Galbulidæ*).*

THESE birds are usually of metallic green plumage, with long beaks and wedge-shaped tails, and are found only in Central and Southern America, where they seem to represent the Bee-eaters of the Old World. Not many notices have appeared of their habits, the best being that given by Mr. Waterton, in his "Wanderings" in Demerara:—"A bird called Jacamar is often taken for a Kingfisher, but it has no relationship to that tribe: it frequently sits in the trees over the water, and as its beak bears some resemblance to that of the Kingfisher, this may probably account for its being taken for one. It feeds entirely upon insects. It sits on a branch in motionless expectation, and as soon as a Fly, Butterfly, or Moth passes by, it darts at it, and returns to the branch it had just left. It seems an indolent, sedentary bird, shunning the society of all others in the forest. It never visits the plantations, but is found at all times of the year in the woods. There are four species of Jacamar in Demerara; they are all beautiful, the largest rich and superb in the extreme. Its plumage is of so fine a changing blue and golden green, that it may be ranked with the choicest of the Humming Birds. Nature has denied it a song, but given a costly garment in lieu of it. The smallest species of Jacamar is very common in the dry savannas. The second size, all golden green in the back, must be looked for in the Wallaba Forest; the third is found throughout the whole extent of these wilds; and the fourth, which is the largest, frequents the interior, where you begin to perceive stones in the ground."

* *Galbula*, a proper name.

THE SECOND FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.
THE PUFF BIRDS (*Bucconidæ*).

In general form the Puff Birds are not unlike Kingfishers, some of which they resemble in their habits, feeding chiefly on insects, which they catch in the air. In many respects also they resemble the Bee-eaters (*Meropidæ*), and may be considered as representing the last-named family in South and Central America, to which countries they are entirely confined. Of the Long-winged Puff Birds (*Chelidoptera tenebrosa*) the late Prince Maximilian of Neuwied gives the following account :—"It is not rare in most provinces of South Brazil, and very common in many of them. It is found in certain spots sitting still and immovable upon the high isolated branches of the forest trees. From time to time it flies after an insect in the air, and falls back again to its place like a true Fly-catcher. It is a stupid, still, melancholy bird, but likes to sit high, and not low and near the ground, like other Puff Birds. As in form and colour it rather resembles a Swallow, the Brazilians call it *Andurinha do mato* (Wood Swallow). The resemblance is greatest when the bird sits upon the ground, for its feet are little adapted for walking, and it consequently shuffles along as a Swallow does. Its flight is light and undulating. Sitting upon a high point, whence it can overlook the neighbourhood, it often emits a short call-note. It is anything but timid, and very easy to shoot. It is usually found where the woods are varied with open country, on the edges of the woods, but likewise in the interior of them. The food of these birds consists of insects, of which I have found the remains in their stomachs. On the Rio Grande del Belmonte I observed how these birds nest. In the month of August I saw them enter a round hole in a perpendicular sand-bank on the river, like a Kingfisher's. After digging about two feet in a horizontal direction, we found two milk-white eggs upon a bad lining of a few feathers." *

THE THIRD FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.
THE KINGFISHERS (*Alcedinidæ*).

The Kingfishers are a very varied family, including within their limits birds of very different form and habits. The bill is always long and powerful for the size of the bird, producing, in some of the smaller species, a top-heavy and ungainly aspect; but this organ is modified according to the habits of the birds, and is strictly in accordance with the functions which it has to perform. The foot is similar in all Kingfishers, the sole being very flat, and the toes joined together for the greater part of their length, so that the birds always have a very firm support to their bodies. The legs are very short and weak, the wings powerful, and the gape very wide. The Kingfishers may be divided into two sub-families, distinguished by the form of the bill, which is long and compressed in the fish-eating Kingfishers (*Alcedininæ*), of which the European bird is a type, with a distinct ridge or keel along the upper mandible; while in the *Daceloninæ*, which have a stouter and flatter bill, with a smooth and rounded culmen, the food is varied, consisting more of insects than of fish.

THE COMMON KINGFISHER (*Alcedo*† *ispida*).

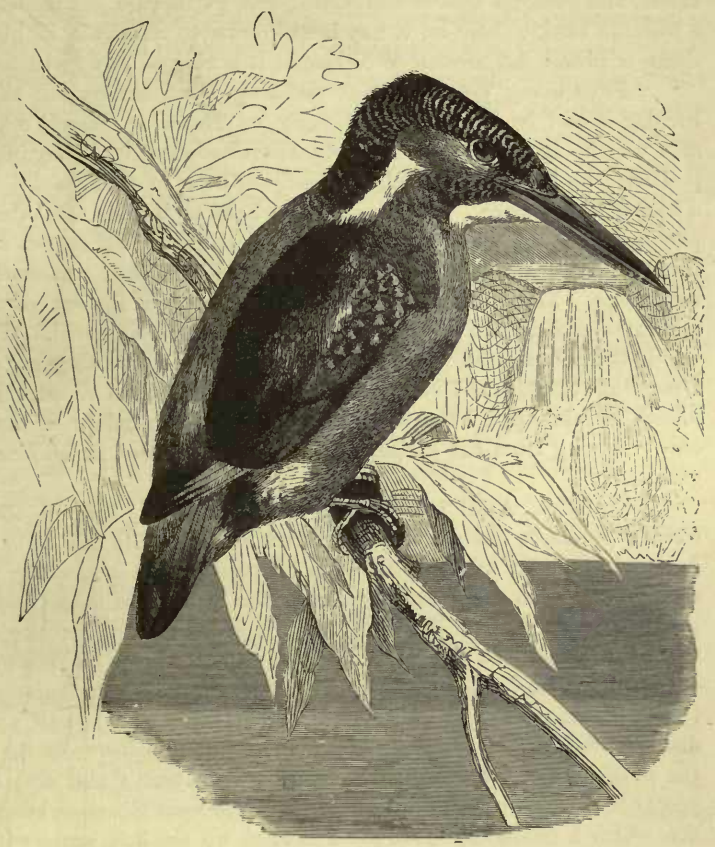
This is, perhaps, the most brilliantly-coloured bird there is in England, but by reason of its shy habits and wonderfully quick flight it is not often observed, excepting as a flash of bright blue on the river side, appearing for an instant and gone the next. It is, however, by no means uncommon in many of the rivers in the south of England, particularly during the month of October, when a partial migration of the species evidently takes place. At this season of the year, the writer once observed a Kingfisher on the ornamental water in St. James's Park. Beyond the British Islands it is found in most parts of the European continent, being replaced in the East by the little Indian Kingfisher (*A. bengalensis*), a miniature of the English bird, but with a much longer bill. The following account of the habits of this bird, the result of several years' close acquaintance with the species on the river Thames, is taken from the author's work on this subject‡ :—"When in a wild state, flying along the banks of a stream, or sitting patiently at watch for its finny prey, the Kingfisher is a beautiful sight. Often has it been our good fortune to witness the bird at close quarters, but this is by no means easy to

* Selater, "Synopis of the Fissirostral Family Bucconidæ," 8vo, 1854.

† *Alcedo*, a Kingfisher.

‡ Sharpe's "Monograph of the Alcedinidæ, or Kingfishers."

accomplish, owing to the extreme wariness of the bird from repeated persecution. The presence of the Kingfisher in one's neighbourhood can be detected from some distance by the faint cry which falls upon the ear from afar. This note, which is a shrill, but not unmusical, scream, generally consists of two syllables, but is very difficult to render in language. Naumann gives it as *ti-ti*, which is by no means a bad representation of the cry; and these syllables are quickly repeated as the bird leaves its perch and skims over the stream. The flight is rapid and very direct, the bird speeding like a bullet a little height above the surface of the water. When suddenly disturbed, it utters its cry shortly after leaving its perch, and then flies for some distance in silence; but when passing unmolested from one resting-place to another, its shrill note may be heard at frequent intervals. Just before perching, the cry is uttered three or four times successively—*ti-ti-ti*. When resting, it sits uprightly, with the glance directed downwards, motionlessly scanning the stream beneath, intent on the capture of any fish or water insect which may come within its reach. Its unerring dive seldom proves fruitless; and when secured, a few smart raps on its perch, to which the bird always returns, deprive the victim of life, after which it is immediately swallowed. Except in the early morning, it seldom chooses a very open position for its resting-place; but in the autumn, when the migration is in progress, at break of day it is not unusual to see two, or even three, birds in company on a rail or on the side of a punt; in the day-time, however, it loves solitude, and seldom more than one can be seen at once, and then it affects more shady and secluded haunts. In general it is a lonely bird, jealous of intrusion, especially from individuals of its own species. Each pair appears to choose and maintain a particular hunting-ground, and should one Kingfisher enter upon the domain of another, it is speedily and effectually ousted by the rightful owner with cries of rage. So fierce is the animosity displayed by these birds, that when excited in combat they fly heedless of obstacles, and thus occasionally meet their death in their headlong career." An instance is on record of two Kingfishers flying with such violence against a window that both pursuer and pursued met their death on the spot. The present species does not always pounce on its prey from a perch, but will occasionally fly out over the mid-stream, and hover in the air like a Kestrel Hawk; and after making an unsuccessful plunge, will repeat its hovering position over the same spot, until its efforts are rewarded with success. It has been seen also to dash into the water several times in succession, which movement has been supposed to be for the purpose of attracting fish to the spot by disturbing the water; it is, however, more probable that in this exercise the bird is taking a bath. The young have exactly the same cry as their parents, but the note is less shrill. On leaving the nest, they often congregate in some well-shaded locality by the side of the stream, where food is brought to them by their parents, and the presence of the nestlings



COMMON KINGFISHER.

is often betrayed by their shrill pipings. The bill in the young birds is very short, and has a little white tip to it; in the adult male it is entirely black; but the female may always be distinguished by the base of the lower mandible being red.

That the Kingfisher makes its own hole is now an ascertained fact, and the following note on the subject was published in 1866 by Mr. G. Dawson Rowley:—"Though the subject of the Kingfisher (*Alcedo ispida*) is somewhat stale, yet, in consequence of the remarks which I have just read in the October *Quarterly* on 'Homes without Hands,' I send you the following notes, made this spring, in order to set at rest, if possible, a mistake regarding the breeding of this bird. Modern writers on the Kingfisher are hardly more free from error than even Ovid or Pliny. The bird is a true miner, and makes a nest of fish-bones; but, as no rule is without an exception, when it cannot find a suitable bank to bore in, it has been known to nidificate in abnormal situations; and when abundance of proper fish are not to be caught it is obliged to do without bones.

"From many years' constant watching, I can exactly tell the probable position of the hole, and the day it will be begun. Accordingly, on Thursday, March 29, I sent two witnesses to a particular spot on the River Ouse, St. Neots, Huntingdonshire. They observed that there was on that day positively no hole of any kind, no vestige of hole, in that bank. On Easter Monday, April 2, I sent a keeper to the place. He reported the hole as begun. On the same day I went in a boat, and, putting a reed up, found it by actual measurement about fifteen inches deep, the moulds being quite fresh outside. Droppings of the bird (which was seen constantly leaving the hole) were visible in two places. There was also a shallow hole a little to the left of the above-mentioned one. This was a failure—either from caprice or some other cause abandoned. We observe the same in Woodpeckers, which will sometimes bore in three or four places before they get one to their liking, a circumstance I particularly remarked in a pair of the Greater Spotted Woodpeckers (*P. major*) last spring. Between March 29 and April 2 the Kingfisher had made two holes. I thought it best now to leave the place, only receiving from the keeper each morning a report, as he went by in his boat, how the bird was going on.

"Saturday, April 7, I made a memorandum: 'I again observe fresh moulds, but not, as we consider, to-day's, but yesterday's: hence I suppose the hole to be nearly finished, if not quite.' Here, I should say, after taking these nests constantly for nearly thirty years, I find twenty-one days is the correct time, from the commencement of the excavation to the end of laying seven eggs. I never had the luck to find eight; Mr. Gould, however, informs me he once did. 'Saturday, April 21. Opened the hole situated in the perpendicular bank to keep off Water-rats. Found by measurement the entrance was twelve inches from the surface of the ground, and about five feet from the water. The length of the ascending gallery was eight inches and a half, and the oval chamber six inches in diameter more. The top of the chamber was nine inches from the surface of the ground. It contained the usual nest of fish-bones, which was one inch and a half deep; and the same, with the seven fresh eggs, are now before me, with two other nests from the same locality. The bird flew off after the first dig, which I commonly made so as to cover up the hole again without disturbance if the full number of eggs had not been laid. There was no excrement in the chamber, but much just outside in the gallery.' The size of the chamber is just sufficient for the owners to turn round pleasantly. When the young birds, which I have seen in every stage, have been some time in the nest, of course the hole gets very foul. Here, then, is a case, capable of being attested by two or three witnesses step by step—and concerning which there can be no doubt—where the Kingfisher is proved to have made its own hole. I have known it when driven from one bank by floods to revert to an old hole of its own making in the previous year; but never has there been an instance of its taking up with the abode of its most deadly enemy, the Water-rat. It is hard to prove a negative, but it is certainly a most unlikely thing for a Kingfisher to enter a rat-hole. No one who has seen the eggs of this species *in situ* as often as I have can deny that the fish-bones are placed with the design of making a nest."

In the British Museum may be seen a nest of the Kingfisher, which was taken by Mr. Gould under the following circumstances:—"On the 18th of April, 1859, during one of my fishing excursions on the Thames, I saw a hole in a precipitous bank, which I felt assured was the nesting-place of a Kingfisher; and on passing a spare top of my fly rod to the extremity, a distance of nearly

three feet, I brought out some freshly-cast bones of fish, convincing me that I was right in my surmise. The day following I again visited the spot with a spade, and, after removing nearly two feet square of the turf, dug down to the nest without disturbing the passage which led to it. Here I found four eggs placed on the usual layer of fish-bones. These I removed with care, and then replaced the earth, beating it down as hard as the bank itself, and restored the turfy sod. A fortnight after the bird was seen to leave the hole again, and my suspicions were aroused that she had taken to her old breeding quarters a second time. I again visited the place on the twenty-first day from the date of my former exploration, and upon passing the top of my fly rod up the hole, found, not only that it was of the former length, but that the female was within. I then took a large mass of cotton-wool from my collecting-box, and stuffed it to the extremity, in order to preserve the eggs from damage during my again laying it open from above. On removing the sod and digging down as before, I came to the cotton-wool, and beneath it was formed a nest of fish-bones the size of a small saucer, the walls of which were fully half an inch thick, together with eight translucent pinky-white eggs, and the old female herself. This nest I removed with the greatest care; and it is now deposited in the proper place for so interesting an object—the British Museum. This mass of bones, then weighing 700 grains, had been cast up and deposited by the bird and its mate in the short space of twenty-one days. Ornithologists are divided in opinion as to whether the fish-bones are to be considered in the light of a nest. Some are disposed to believe them to be the castings and fæces of the young brood of the year, and that the same hole being frequented for a succession of years, a great mass is at length formed; while others suppose that they are deposited by the parents as a platform for the eggs, constituting, in fact, a nest; and I think, from what I have adduced, we may fairly conclude this is the case: in fact, nothing could be better adapted to defend the eggs from the damp earth." In ancient times there was a legend that when the Kingfishers made their nests—which were supposed to float upon the top of the sea—fine weather was always allowed to prevail.* A custom used formerly to be in vogue in England of turning a Kingfisher into a weathercock; and, according to the late M. Jules Verreaux, this practice is pursued in France even in the present day, where the bird is mummified and suspended by a thread with extended wings in order to show the direction of the wind. Mr. Harting alludes to these superstitions in his "Ornithology of Shakespeare" (p. 275). It was formerly believed that during the time the Halcyon, or Kingfisher, was engaged in hatching her eggs, the water, in kindness to her, remained so smooth and calm that the mariner might venture on the sea with the happy certainty of not being exposed to storms or tempests; this period was therefore called, by Pliny and Aristotle, "the halcyon days."

"Expect Saint Martin's summer, *halcyon* days."
Henry VI., Part i., Act i., sc. 2.

It was also supposed that the dead bird, carefully balanced and suspended by a single thread, would always turn its beak towards that point of the compass from which the wind blew. Kent, in *King Lear* (Act ii. sc. 2), speaks of rogues who—

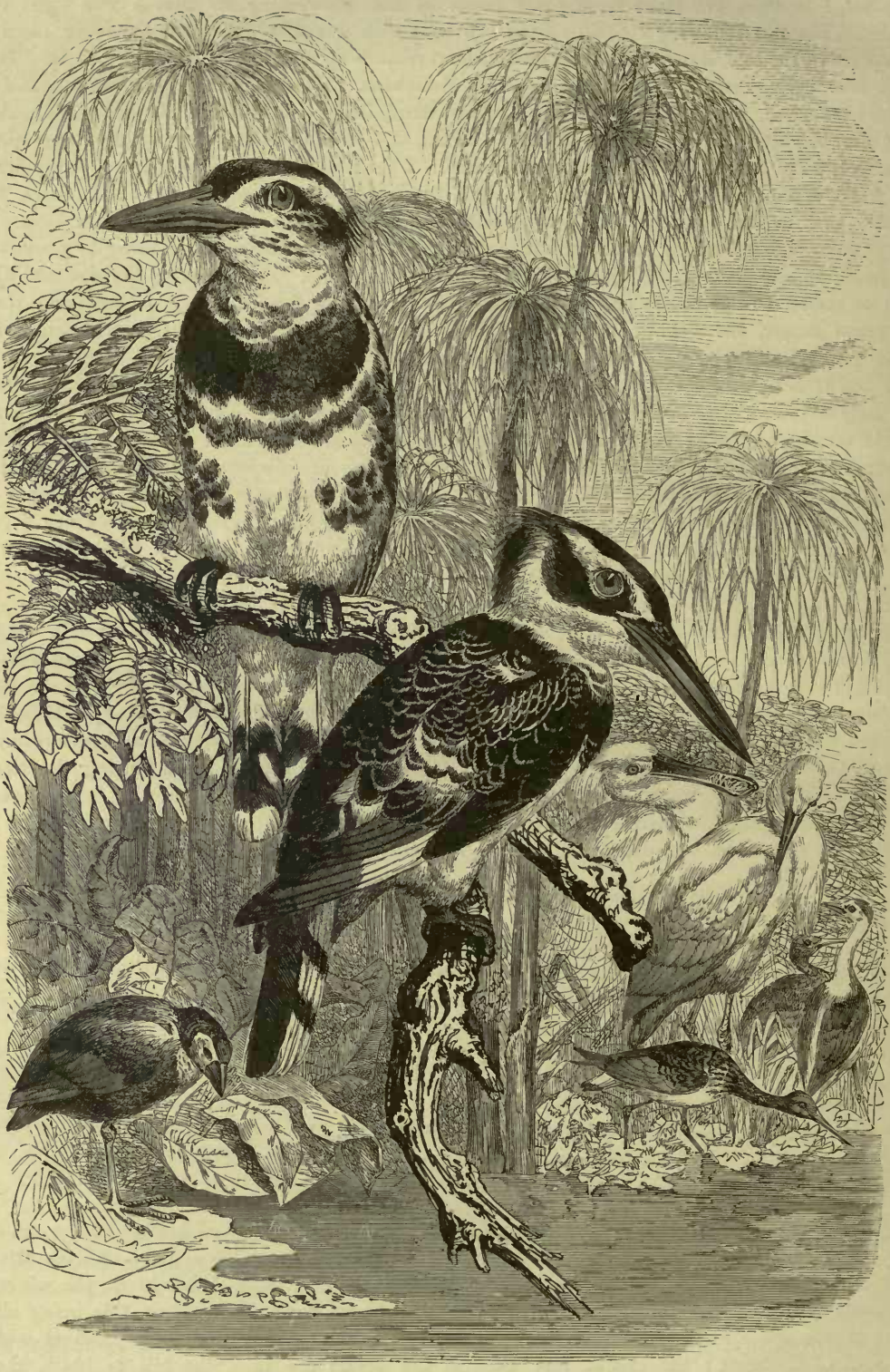
"Turn their *halcyon* beaks
With every gale and vary of their masters."

And, after Shakspere, Marlowe, in his *Jew of Malta*, says:—

"But how now stands the wind?
Into what corner peers my *halcyon's* bill?"

The Common Kingfisher measures about seven inches from the tip of his bill to the end of his tail. The colour of the upper parts is blue, greener on the mantle and scapulars, and beautiful rich cobalt on the back, rump, and upper tail-coverts; the head is blue, barred with black, the wings blue, with spots of brighter cobalt on the coverts; in front of the eye is a spot of rufous, this being also the colour of the eye-coverts and under parts; the throat is white, and there is a patch of white on each side of the neck; the cheeks and sides of the breast are blue, the bill is black, the feet

* "Perque dies placidos hiberno tempore septem
Incubat alcyone pendentibus æquore nidis."—Ovid, Met. xi. 745.



PIED KINGFISHER.

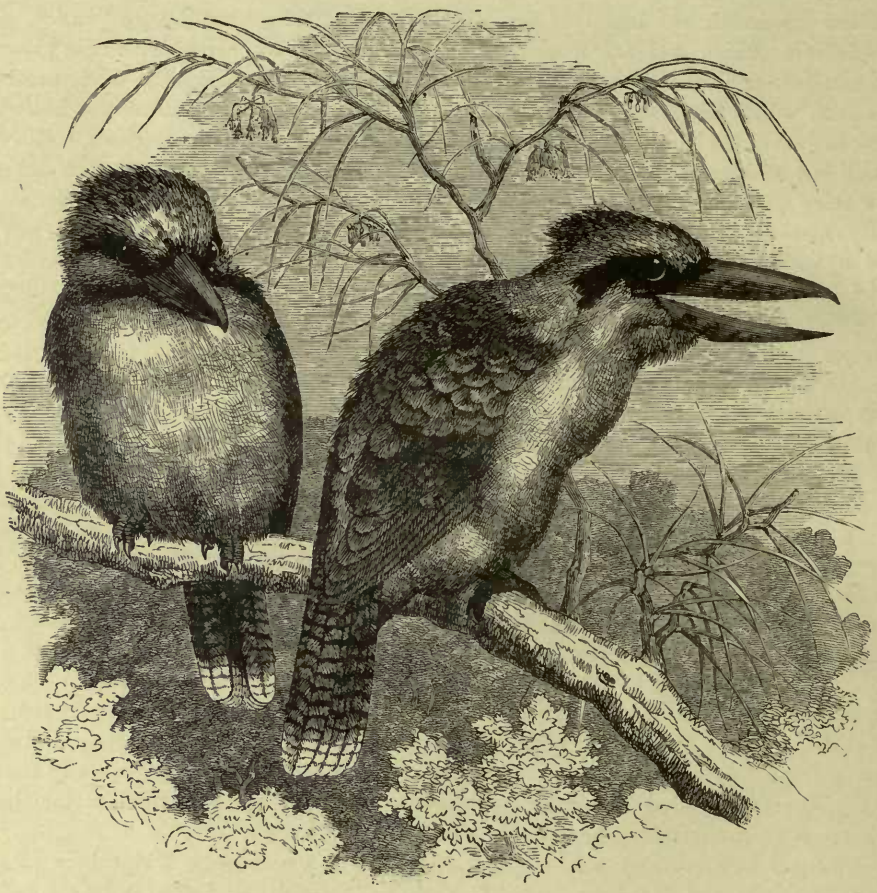
red. The female is coloured like the male, but can always be told by the red colour at the base of the under mandible. This is also present in young birds of both sexes, but the latter can readily be distinguished by their shorter bills.

Species of the genus *Alcedo* are distributed over the greater part of the Old World, extending even into the Molucca Islands, but in Australia and the Papuan group they are represented by the genus *Alcyone*, comprising Kingfishers of similar form to the English bird, but distinguished by the absence of the inner toe. In Africa and Madagascar some beautiful little crested Kingfishers (*Corythornis*) are met with, the largest of which scarcely exceeds five inches in length. A very familiar species on the banks of the Nile is the Pied Kingfisher (*Ceryle* * *rudis*), one of the commonest birds in Africa and India, and of this species Dr. von Heuglin writes †:—"It lives in pairs, is sociable, and, except during the breeding season, more friendly with members of its own species than other Kingfishers, and often several pairs dwell in the same neighbourhood. It sits and watches along the shore on overhanging branches, on roofs, walls, brickets, rocks, and even on the ground, but seldom pounces from the latter on its prey. From time to time it takes a flight over shallow clear water, also right across the river or from one island to another, sometimes very low, generally, however, several fathoms above the surface. Its flight is not very swift, but straight, and steadied by quick, fluttering motions of the wing—not rushing, like that of *Alcedo ispida*—and it rises and falls according to will and with great agility. One often sees it, after taking a start by several quick flaps of the wing, and gliding on for a distance, suddenly, with one quick movement, alter the direction of the flight and suddenly stop and hover. When hovering, the bill is held straight down, and the hind part of the body and tail also rather lowered. Directly it catches sight of its scaly prey it turns up, lays its feathers close to the body, and drops like a stone into the water, remaining often over ten seconds below the surface. It seldom misses its mark, and devours the fish it has captured either on the wing or at one of its resting-places. The voice is a shrill whistle, at the same time chirpy, or at times snickery. During the pairing time the males often fight on the wing, and roll together, calling loudly, nearly to the surface of the water. In Egypt the breeding season is our spring; according to Adams, as early as December. The nest, consisting of a small heap of clean dry grass, is placed in a horizontal hole about arm's depth in a steep bank, and contains four to six pure white roundish eggs, the shell of which is rather rough compared with that of *Alcedo ispida*. Often several nest-holes are close together. The plumage of the young much resembles that of the adult. There is scarcely any bird on the Nile tamer than the Black and White Kingfisher." The genus *Ceryle*, to which the foregoing species belongs, is largely represented in the New World, one of the best known being the Belted Kingfisher of North America, and an unusual circumstance in fish-eating Kingfishers is characteristic of the genus, viz., a difference in the colouring of the sexes. The Stork-billed Kingfishers (*Pelargopsis*‡) are the most powerful members of the sub-family, some of them measuring nearly a foot and a half in length.

More difference in form and size is perceptible in the omnivorous Kingfishers (*Daceloninæ*), where some of the little three-toed species of *Ceyx* do not exceed five inches in length, whereas the Great Laughing Jackasses of Australia (*Dacelo*) attain the dimensions of more than a foot and a half. The smaller birds of this section feed almost entirely on insects, and the Rose-cheeked Kingfisher of Africa (*Ispidina* § *picta*) feeds principally on Grasshoppers and small Locusts, while its representative in Natal (*I. natalensis*) is said to feed entirely on Butterflies and insects caught on the wing. They are often found along the banks of rivers, but never catch fish. The large genus *Halcyon* is distributed all over Africa, and ranges throughout Southern Asia, through China, to Japan, inhabiting also the islands of the Malay Archipelago and the entire Continent of Australia. These birds prefer a mixed diet, and, in addition to an occasional fish, they will also eat crustacea, small reptiles, and insects. Perhaps the most beautiful of all the Kingfisher family are the *Tanysipteræ*, ‖ which are found only in New Guinea, the adjacent Moluccas, and the north-east peninsula of Australia. These birds have only ten tail-feathers, the middle pair being very much longer than the rest, and ending in a spatule or racket. They live entirely in the forests, feeding on insects, and they are said to roost in the holes of rocks by the side of small streams. The best known species of *Tanysiptera*

* κηρύλος, a sea-bird of the halcyon kind. † "Ornithologie Nord Ost Afrikas," p. 185.
‡ πελαργός, a stork; ὤψ, a face. § Diminutive of *Ispida*, a Kingfisher. ‖ τανύω, to stretch; πτερόν, a wing.

is the Australian Cinnamon-breasted Kingfisher (*T. sylvia*), which was discovered by the late Mr. John Macgillivray, who gives the following account of its habits :—"This pretty *Tanysiptera* is rather plentiful in the neighbourhood of Cape York, where it frequents the dense bushes, and is especially fond of resorting to the sunny openings in the woods, attracted, probably, by the greater abundance of insect food found in such places than elsewhere. I never saw it on the ground, and usually was first made aware of its presence by the glancing of its bright colours as it darted past with a rapid arrow-like flight, and disappeared in an instant amongst the dense foliage. Its cry, which may be



LAUGHING JACKASS.

represented by *whee-whe-whee* and *wheet-wheet-wheet*, is usually uttered when the bird is perched on a bare, transverse branch, or woody, rope-like climber, which it uses as a look-out station, and whence it makes short dashes at any passing insect or small Lizard, generally returning to the same spot. It is a shy, suspicious bird, and one well calculated to try the patience of the shooter, who may follow it for an hour without getting a shot, unless he has as keen an eye as a native, to whom I was indebted for first pointing it out to me. According to the natives, who know it by the name of *Quatawur*, it lays three white eggs in a hole dug by itself in one of the large ant-hills of red clay which form so remarkable a feature in the neighbourhood, some of them being as much as ten feet in height, with numerous buttresses and pinnacles. I believe that the bird also inhabits New Guinea; for at Redscar Bay, on the south-east of that great island, in long. 146° 15′ E., a head strung upon a necklace was procured from the natives."

The largest of all the Kingfishers are the Laughing Jackasses of Australia, this curious name being given to the bird from its strange note and peculiar look, both of which can be appreciated

by any visitor to the London Zoological Gardens, where there is generally one, if not two, out of the seven species known. Of the bird in its native haunts a very good idea is given us by the "Old Bushman," the late Mr. Henry Wheelwright, which is here taken from a little work called the "Bush Wanderings of a Naturalist." "About an hour before sunrise the bushman is awakened by the most discordant sounds, as if a troop of fiends were shouting, whooping, and laughing around him in one wild chorus: this is the morning song of the 'Laughing Jackass,' warning his feathered mates that daybreak is at hand. At noon the same wild laugh is heard, and as the sun sinks into the west it again rings through the forest. I shall never forget the first night I slept in the open bush in this country. It was in the Black Forest. I woke about daybreak, after a confused sleep, and for some minutes I could not remember where I was, such were the extraordinary sounds that greeted my ears; the fiendish laugh of the Jackass, the clear, flute-like note of the Magpie, the hoarse cackle of the Wattle-birds, the jargon of flocks of Leatherheads, and the screaming of thousands of Parrots as they dashed through the forest, all joining chorus, formed one of the most extraordinary concerts I have ever heard, and seemed at the moment to have been got up for the purpose of welcoming the stranger to this land of wonders on that eventful morning. I have heard it hundreds of times since, but never with the same feelings that I listened to it then. The Laughing Jackass is the bushman's clock, and being by no means shy, of a companionable nature, a constant attendant about the bush-tent, and a destroyer of Snakes, is regarded, like the Robin at home, as a sacred bird in the Australian forests. It is an uncouth-looking bird, a huge species of land Kingfisher, nearly the size of a Crow, of a rich chestnut brown and dirty white colour; the wings slightly chequered with light blue, after the manner of the British Jay; the tail-feathers long, rather pointed, and barred with brown. It has the foot of a Kingfisher; a very formidable, long, pointed beak, and a large mouth; it has also a kind of crest, which it erects when angry or frightened, and this gives it a very ferocious appearance. It is a common bird in all the forest throughout the year; breeds in a hole of a tree, and the eggs are white; generally seen in pairs, and by no means shy. Their principal food appears to be small reptiles, grubs, and caterpillars. As I said before, it destroys Snakes. I never but once saw them at this game: a pair of Jackasses had disabled a Carpet-Snake under an old gum-tree, and they sat on a dead branch above it, every now and then darting down and pecking it, and by their antics and chattering seemed to consider it a capital joke. I can't say whether they ate the Snake—I fancy not; at least the only reptiles I have ever found in their stomachs have been small Lizards. The first sight that struck me on landing in London was a poor old Laughing Jackass moped up in a cage in Ratcliffe Highway. I never saw a more miserable, woe-begone object. I quite pitied my poor old friend, as he sat dejected on his perch; and the thought struck me at the time that we were probably neither of us benefited in changing the quiet freedom of the bush for the noise and bustle of the modern Babylon." The Common Laughing Jackass has the sexes alike, but in all the other species the male has a blue tail and the female a red one.

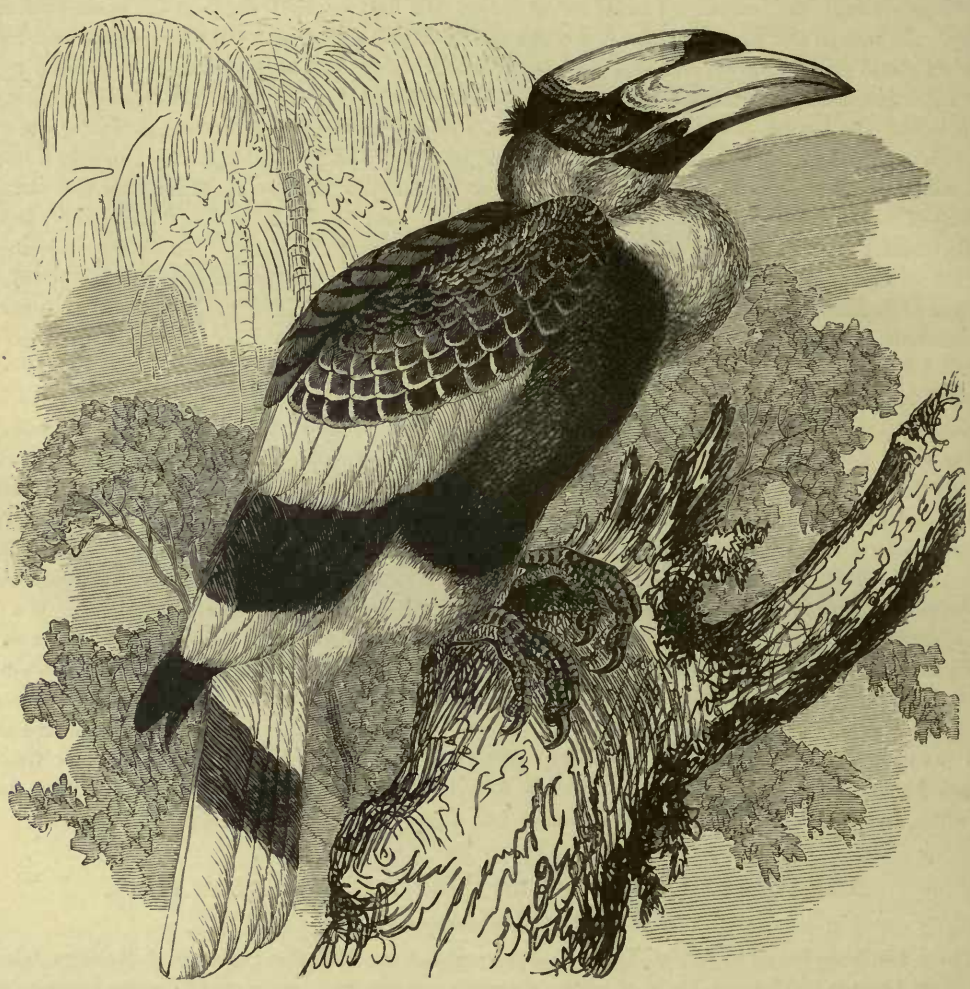
THE FOURTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.

THE HORNBILLS (*Bucerotidæ*).

These birds are found in Africa, India, and throughout the Malayan region and Molucca Islands, as far as New Guinea. They are birds of rather ungainly appearance, nearly every species having a casque, or helmet, which is developed in every variety of shape, and in some of them reaches an extraordinary size. The flat soles which were alluded to in the Kingfishers are here developed in a greater degree, and the toes are united together in exactly the same way. The flight, however, of the Hornbills is very different from that of the Kingfishers, being heavy and performed with an abundance of noise: so much so that some explorers in South-eastern New Guinea have been led to speak of a bird whose wings, when flying, produced a noise "resembling a locomotive," but which was doubtless made by the large Hornbill (*Buceros* ruficollis*), which frequents that part of the world. They are generally found on very lofty trees and at a great height, which makes them difficult to shoot; and Governor Ussher says that in ascending the lonely forest-clad rivers of North-western Borneo the only sign of life is often a solitary Hornbill flying across at a great height in the air. Wallace states that the Rhinoceros Hornbill (*Buceros rhinoceros*), a native of the Malayan Peninsula and Borneo,

* βούκερως, having the horn (κέρας) of a cow (βοῦς).

finds the exertion of flying so great that it is compelled to rest at intervals of about a mile; and the same author says that he heard the Great Hornbill (*Dichoceros bicornis*) more than a mile off, so that the amazement caused by one of these large birds to the travellers in New Guinea, as mentioned above, does not seem so very inexplicable. The voice of the last-named species is said to be very harsh and grating, and the noise it makes is compared by Wallace to something between the bray of a Jackass and the shriek of a locomotive, and is not to be surpassed, probably, in power by any sound that an animal is capable of making. Tickell says that its roar re-echoes through the hills to such a degree



GREAT HORNBILL.

that it is difficult to assign the noise to a bird; and Wallace observes that this is kept up so continuously as to be absolutely unbearable. The flight is heavy, and performed by repeated flappings of its huge wings. It usually flies in a straight line, and sails only when about to alight upon some tree.*

The food of the Hornbills consists principally of fruits, but under certain circumstances they become to a great extent omnivorous, and will devour anything, some of the species searching the ground for Lizards, which they devour readily, both when wild and in confinement; and the Pied Hornbill (*Anthracoceros malabaricus*) is stated by Mr. Inglis to be very fond of live fish, which it catches in shallow pools. The way he discovered this predilection for an abnormal diet was as follows: he possessed a tame Otter and three tame Hornbills; at feeding time the Otter was placed in a tub

* Elliot: "Monograph of the Bucerotidæ, or family of the Hornbills," Part IV.

containing live fish, and these, when closely pressed, would jump out to escape from their pursuer, and were immediately swallowed by the Hornbills. Mr. Inglis has also found bones of fish in the stomachs of birds which he had shot; and the natives of the Naga Hills affirm that when these Hornbills are intent on fishing they can be approached sufficiently close to be killed by a stick.

By far the most curious habit belonging to these birds is that which takes place during the breeding season, when the male bird plasters the female into a hollow tree, there to hatch her eggs, nor does he release her until the young ones are nearly full grown. It is scarcely possible to conceive a practice more detrimental to the well-being of any bird than this. The exertion of feeding himself as well as his wife and nestlings must entail a serious strain upon the male, while the destruction of the latter must inevitably ensure the starvation of the female and of the young birds. This curious habit has been well attested by observers in Asia as well as in Africa; and the writer once received from an old negro collector on the West Coast of Africa, who rejoiced in the name of St. Thomas David Aubinn, and styled himself "Royal Hunter to the King of Denkera," an adult female of the Black Hornbill (*Sphagolobus atratus*), together with a nearly full-grown young one, which, he said, had been taken by him together out of the hole of a tree; and the habits of the Hornbill in this respect were given by him in the following words: "When the female go to sit, the male he her shut in tree. If he no bring food, then she angry. If he no then bring food, then she more angry—swear. If he no then bring food, then she curse him for die. Man—beef—beefy—beef!"

If the last sentence is intended to represent the enraged Hornbill, it is evident that the noises produced by the bird are not of that startling character ascribed to the Eastern species by Wallace, as mentioned above. All accounts seem to agree that the female is shut in the hollow of a tree; but Dr. Kirk noted an exception, on native authority, and therefore one which must be confirmed by future research. This is the Crested Hornbill (*Bycanistes cristatus*), which is a common bird on the river Shiré, where it goes in large flocks, and roosts regularly in the same places. "The natives say that the female hatches her eggs in a hole underground, in which she is fastened by the male." Our astonishment at the imprisonment of the female Hornbill is not lessened when it is found that the male bird keeps her supplied with food by a most curious process, which accounts for the statement of Dr. Livingstone *:—"The first time I saw this bird was at Kolobeng, where I had gone to the forest for some timber. Standing by a tree, a native looked behind me and exclaimed, 'There is the nest of a Korwe.' I saw a slit only, about half an inch wide and three or four inches long, in a slight hollow of a tree. Thinking the word Korwe denoted some small animal, I waited with interest to see what he would extract. He broke the clay which surrounded the slit, put his arm into the hole, and brought out a Tockus, or Red-beaked Hornbill, which he killed. He informed me that when the female enters her nest she submits to a real confinement. The male plasters up the entrance, leaving only a narrow slit by which to feed his mate, and which exactly suits the form of his beak. The female makes a nest of her own feathers, lays her eggs, hatches them, and remains with the young till they are fully fledged. During all this time, which is stated to be two or three months, the male continues to feed her and the young family. The prisoner generally becomes quite fat, and is esteemed a very dainty morsel by the natives; while the poor slave of a husband gets so lean that on the sudden lowering of the temperature, which sometimes happens after a fall of rain, he is benumbed, falls down, and dies." At a meeting of the Zoological Society on the 25th February, 1869, Mr. A. D. Bartlett produced a curious envelope, which had been thrown by a Wrinkled Hornbill (*Anorrhinus corrugatus*) in the Zoological Gardens of London, which was found to contain plums or grapes well packed together; and Mr. Bartlett came to the conclusion that it was by means of fruit packed together in such a wrapper that the male fed the female during her confinement in the hollow tree. In 1874, Dr. Murie exhibited to the same society some similar envelopes, or, as he more properly called them, gizzard sacs, which had been thrown up by a specimen of Sclater's Hornbill (*Bycanistes subcylindricus*) in the same way as by the previous bird. On examination, these gizzard sacs proved to be the interior lining of the bird's stomach; and it was evident, from the short time that elapsed between the throwing up of the envelopes, that, as Dr. Murie observed, the bird in the interval had made a new one, and got rid of it also, without apparently being any the worse. One can readily imagine, however, that this process, being continued during the long period that the female is shut up in the hole of the tree, must tend

* "Missionary Travels in South Africa."

greatly to weaken the bird. The habit of feeding his mate seems to be inherent in every Hornbill, even in captivity, for Mr. Bartlett observes :—"The tame male Hornbill is particularly distinguished at all seasons by this habit of throwing up his food, which he not only offers to the female, but to the keepers and others who are known to him. The male Concave Hornbill (*Buceros cavatus*) now in the Gardens will frequently throw up grapes, and, holding them in the point of the bill, thrust them into the mouth of the keeper, if he is not on the alert to prevent or avoid this distinguished mark of his kindness."

Mr. Wallace thus describes the habits of the Hornbills, as observed by him during his travels in the East, and he points out certain peculiarities, proving that the old systematic position of these birds near the Toucans of America is erroneous :—"From an examination of the structure of the feet and toes, and from a consideration of their habits, we are led to conclude that the Hornbills are Fissirostral birds, though of a very abnormal form. Their very short legs and united toes, with a broad flat sole, are exactly similar to those of the Kingfishers. They have powerful wings, but their heavy bodies oblige them to use much exertion in flight, which is not therefore very rapid, though often extended to considerable distances. They are (in the Indian Archipelago, at least) entirely frugivorous, and it is curious to observe how their structure modifies their mode of feeding. They are far too heavy to dart after the fruit in the manner of the Trogons; they cannot even fly quickly from branch to branch, picking up a fruit here and a fruit there; neither have they strength or agility enough to venture on the more slender branches with the Pigeons and Barbets; but they alight heavily on a branch of considerable thickness, and then, looking cautiously round them, pick off any fruits that may be within reach, and jerk them down their throats by a motion similar to that used by the Toucans, which has been erroneously described as throwing the fruit up in the air before swallowing it. When they have gathered all within their reach they move sideways along the branch by short jumps, or, rather, a kind of shuffle, and the smaller species even hop across to other branches, when they again gather what is within their reach. When in this way they have progressed as far as the bough will safely carry them, they take a flight to another part of the tree, where they pursue the same course. It thus happens that they soon exhaust all the fruit within their reach; and long after they have left a tree the Barbets and *Eurylaimi* find abundance of food on the slender branches and extreme twigs. We see, therefore, that their very short legs and syndactyle feet remove them completely from the vicinity of the Toucans, in which the legs are actively employed in moving about after their food. Their wings, too, are as powerful as those of the Toucans are weak; and it is only the great weight of their bodies that prevents them from being capable of rapid and extensive flight. As it is, their strength of wing is shown by the great force with which they beat the air, producing a sound, in the larger species, which can be distinctly heard a mile off, and is even louder than that made by the flight of the great Muscovy Duck." Mr. Wallace * also describes the capture of a young Hornbill in Sumatra :—"I returned to Palembang by water, and while staying a day at a village while a boat was being made water-tight, I had the good fortune to obtain a male, female, and young bird of one of the large Hornbills. I had sent my hunters to shoot, and while I was at breakfast they returned, bringing me a fine large male of the *Buceros bicornis*, which one of them assured me he had shot while feeding the female, which was shut up in a hole in a tree. I had often read of this curious habit, and immediately returned to the place, accompanied by several of the natives. After crossing a stream and a bog, we found a large tree leaning over some water, and on its lower side, at a height of about twenty feet, appeared a small hole, and what looked like a quantity of mud, which I was assured had been used in stopping up the large hole. After a while we heard the harsh cry of a bird inside, and could see the white extremity of its beak put out. I offered a rupee to any one who would go up and get out the bird, with the egg or young one, but they all declared it was too difficult, and they were afraid to try. I therefore very reluctantly came away. In about an hour afterwards, much to my surprise, a tremendous loud, hoarse screaming was heard, and the bird was brought me, together with a young one, which had been found in the hole. This was a most curious object, as large as a pigeon, but without a particle of plumage on any part of it. It was exceedingly plump and soft,

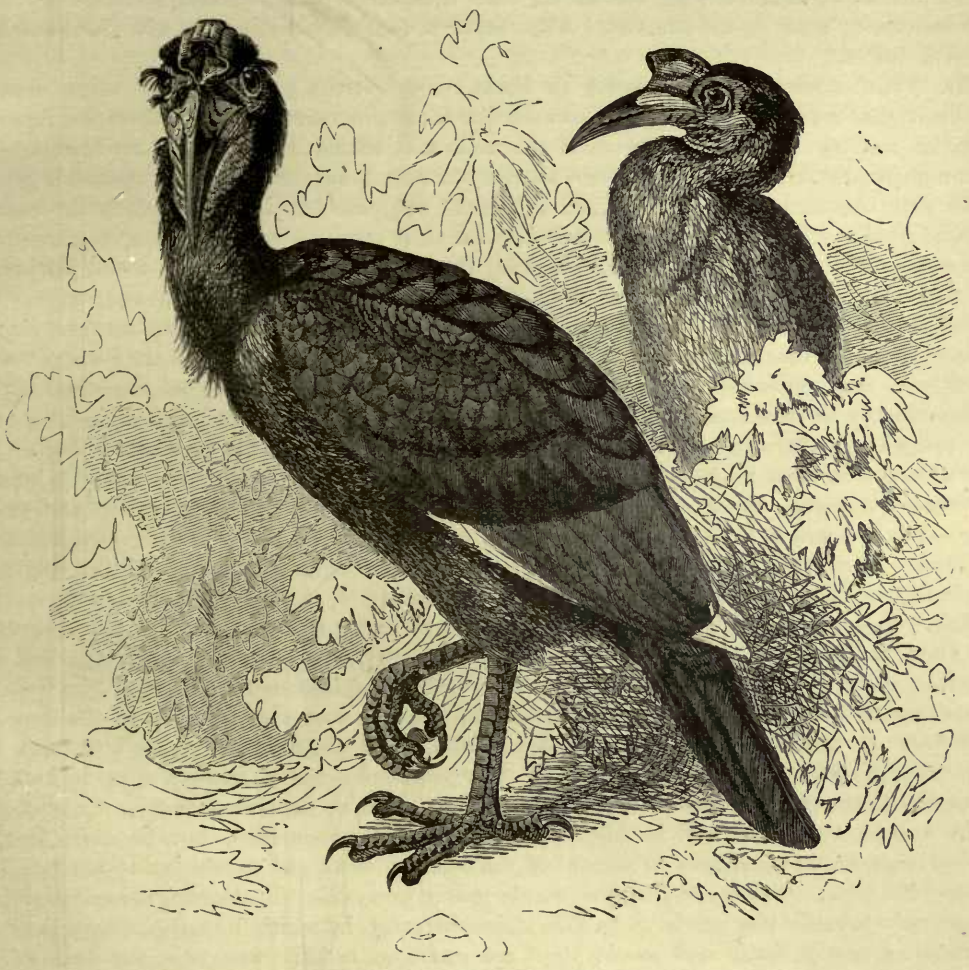
* "Malay Archipelago," Vol. I., p. 212.

and with a semi-transparent skin, so that it looked more like a bag of jelly, with head and feet stuck on, than like a real bird."

One genus of these Hornbills is so remarkable as to demand a special notice.

THE GROUND HORNBILLS (*Bucorax*).

These are an African form, of which there are two or three kinds, distinguished by the casque, which is open in the birds from Abyssinia, compressed and shut in the South African species (*B. cafer*).



GROUND HORNBILLS OF ABYSSINIA.

Of the habits of the latter bird several accounts have been written, from which a few extracts are made; and the first is from a letter sent by Mr. Henry Bowker to Mr. Layard, after the publication of the latter's "Birds of South Africa"* :—"There are many superstitions connected with the 'Bromvogel.' The bird is held sacred by the Kaffirs, and is killed only in times of severe drought, when one is killed by order of the 'rain-doctor,' and its body thrown into a pool in a river. The idea is that the bird has so offensive a smell that it will 'make the water sick,' and that the only way of getting rid of this is to wash it away to the sea, which can only be done by heavy rains and flooding of the river. The ground where they feed is considered good for cattle, and in settling in a new country, spots frequented by these birds are chosen by the wealthy people. Should the birds, however, by some chance, fly over a cattle kraal, the kraal is moved to some other place. They are mostly found in

* See Sharpe's Edition of Layard's "Birds of South Africa," p. 122.

groups of from three to six or seven, and build their nests in hollow trees, or in the hollow formed by three or four branches striking off from the same spot. They roost in tall yellow-wood trees, and commence calling about daylight. I never saw one eating carrion, as stated in your book, though I have frequently seen them near the bones of dead cattle, picking up beetles and worms. They will eat meat, mice, and small birds, and swallow them by throwing them suddenly in the air, and letting them drop down the throat in falling. I once had a tame one, and noticed this particularly. It is very weak on the wing, and when required by the 'doctor,' the bird is caught by the men of a number of kraals turning out at the same time, and a particular bird is followed from one hill to another by those on the look-out. After three or four flights it can be run down and caught by a good runner."

Mr. Ayres' account of the species in Natal, though often referred to by other writers, is so excellent that no work treating of South African birds can omit it, and is therefore reproduced here in its entirety:—"In the stomach of the male were snakes, beetles, and other insects. These birds are gregarious, and to be found here all the year round, but are not very plentiful, generally three or four, sometimes more, being found together. They are very fond of hunting for their food on ground from which the grass has been burnt; with their strong bills they peck up the hard ground and turn over lumps in search of insects, making the dust fly again. Having found an insect or other food they take it up, and giving their head a toss, the bill pointing upward, appear to let the food roll down their throat. They also kill large snakes in the following manner, viz.:—On discovering a snake, three or four of the birds advance sideways towards it with their wings stretched out, and with their quills flap at and irritate the snake till he seizes them by the wing-feathers, when they immediately all close round and give him violent pecks with their long and sharp bills, quickly withdrawing again when the snake leaves his hold. This they repeat till the snake is dead. If the reptile advances on them they place both wings in front of them, completely covering the heads and most vulnerable parts. Their call, which consists of but one note repeated—a deep and sonorous *coo-coo*—may be heard at a great distance. I have myself heard it, under favourable circumstances, at a distance of nearly two miles. The call of the female is exactly the same *coo-coo*, only pitched one note higher than the male. The latter invariably calls first, the female immediately answering, and they continue this perhaps for five or ten minutes, every now and then, as they are feeding. Their flight is heavy, and when disturbed, although very shy, they seldom fly more than half a mile before they alight again. At a distance they would easily be mistaken for Turkeys, their body being deep and rather compressed, similarly to those birds, with the wings carried well on the back. The little pouch on the throat they are able to fill with air at pleasure, the male bird sent to me to London doing this before he died. I think their principal range of country is on the coast and from twenty to thirty miles inland. They roost on trees at night, but always feed on the ground."

In Angola, where the bird is called by the natives *Engungoashito*, Mr. Monteiro had great difficulty in procuring specimens, on account of the superstitious dread in which they are held by the natives. He says:—"They are found sparingly nearly everywhere in Angola, becoming abundant, however, only towards the interior. In the mountain range in which Pungo Andongo is situated, and running nearly north and south, they are common, and it was near the base of these mountains that I shot these two specimens. They are seen in flocks of six or eight (the natives say always in equal numbers of males and females). Farther in the interior I was credibly informed that they are found in flocks of from one to two hundred individuals. The males raise up and open and close their tails exactly in the manner of a Turkey, and filling out their bright cockscomb-red, bladder-like wattle on their necks, and with wings dropping on the ground, make quite a grand appearance. They do not present a less extraordinary appearance as they walk slowly with an awkward gait, and peer from side to side with their great eyes in quest of food in the short grass, poking their large bills at any frog, snake, &c., that may come in their way. Their flight is feeble and not long sustained. When alarmed, they generally fly up to the nearest large tree, preferring such as have thick branches with but little foliage, as the *Adansonia*, 'Muenzo' (a wild fig). Here they squat close on the branches, and, if further alarmed, raise themselves quite upright on their legs in an attitude of listening, with wide open bills. The first to notice a person at once utters the customary cry, and all fly off to the next tree. They are very wary, and the grass near the mountains being comparatively

short, with but little scrub or birch, it is very difficult to approach without being observed by them from the high trees. I followed a flock of six for upwards of two hours, crawling flat on my stomach, negro fashion, before I obtained a chance of a shot, when I was so fortunate as to break the wing of a male without otherwise injuring it. It was quickly captured by the blacks. They are omnivorous in their food; reptiles, birds, eggs, beetles, and all other insects, mandioca roots, ginguba or ground-nuts, constitute their food in the wild state. In confinement I have fed this bird upon the same food, also upon fresh fish, which it showed itself very fond of, as well as on entrails of fowls, &c. On letting it loose in Loanda in a yard where there were several fowls with chickens, it immediately gulped down its throat six of the latter, and finished its breakfast with several eggs! The note or cry of the male is like the hoarse blast of a horn, repeated short three times, and answered by the female in a lower note. It is very loud, and can be heard at a considerable distance, particularly at night. They are said to build their nests on the very highest *Adansonias*, in the hollow or cavity formed at the base or junction of the branches with the trunk."

The present species is of a very large size, measuring about forty inches in length, and about nineteen inches in the wing. It is entirely black, with the exception of the primary quills, which are white; the bill and legs are black, but the bare skin on the neck and round the eye is bright red in the male, but blue in the female.

THE FIFTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.

THE HOOPOES (*Upupidæ*).

Different as these birds are in appearance and habits, ornithologists now agree that from their structure they must be placed in close alliance with the Hornbills, with which they are more particularly connected by the Wood Hoopoes. Instead of the ungainly figures and top-heavy-looking casques of the Hornbills, the Hoopoes are remarkable for their graceful carriage and elegant figure, in which the beautiful crest plays an important part. They are particularly at home in the desert countries, where their sandy-coloured plumage is no doubt a great protection to them; and a story is told that the Hoopoe, if it sees a Hawk approaching, will throw itself flat on the ground, and by twisting its wings round in front and remaining motionless, with its bill pointing upwards, it will look like a piece of old rag, and thus escape detection.

Not more than five species of Hoopoe are known, all inhabitants of the Old World, and the most widely distributed is the Common Hoopoe (*Upupa epops*) of Europe, which visits England during the spring and autumn migration, and at least one instance of its breeding in that country is known. Mr. Howard Saunders states * :—"In the year 1847 a pair of Hoopoes nested in a hole of an old yew-tree in a shrubbery of an old-fashioned garden at Leatherhead, Surrey. The proprietor was very anxious that the birds should not be disturbed, and a strict veto was placed upon any bird's-nesting in the shrubbery—a severe trial to our boyish propensities; but we were afterwards rewarded by seeing the parent birds with their young strutting about upon the lawn. As well as I remember, there were five young ones besides the two old birds." The species is found all over central and southern Europe in summer, being in some places very plentiful; but it is a rare visitor to the northern parts, and has disappeared from some countries, like Denmark, for instance, where the felling of the old and hollow forest trees has deprived it of its accustomed breeding-places. In some places the bird is disliked, and in Scandinavia, where it occurs only in the southern and central portions, it bears a bad name among the peasantry, who suppose it to be a foreboder of war and hard times, and from this circumstance its name of Härfugel or "army bird," is derived. The Chinese also have an objection to them, branding them by the name of "Coffin-bird," as they often breed in the holes of exposed Chinese coffins. On the other hand, according to Canon Tristram, in the Sahara the Arabs have a superstitious veneration for the Hoopoe, and its magical properties enter largely into the arcana of the Arab "hakeem." He says that great numbers of Hoopoes resort to the M'zab cities and frequent oases in winter, where they strut about the courtyards and round the tents with the familiarity of barn-door fowls. Mons. Favier says, that in Tangier the superstitious Jews and Mahomedans both believe that the heart and feathers of the Hoopoe are charms against the machinations of evil spirits.

* Sharpe and Dresser, "Birds of Europe," Part VII., 1871.

The ordinary name of Hoopoe is derived from the note of the bird, and in most European languages the latter suggests the vernacular names. Thus, in Bulgaria it is called *Poo-poo*, in Valentia *Put-Put*, *Bubbula*, &c., in Italy, *Poupa* in Portugal, and so on. Mr. Swinhoe writes of the bird and its note as follows :—"I have already described the peculiar way in which the Hoopoe produces its notes—by puffing out the sides of its neck, and hammering on the ground at the production of each

COMMON HOOPOE.

note, thereby exhausting the air at the end of the series of three, which makes up its song. Before it repeats its call, it repeats the puffing of the neck with a slight gurgling noise. When it is able to strike its bill, the sound is the correct *hoo-hoo-hoo ;* but when perched on a rope, and only jerking out the song with nods of the head, the notes more resemble the syllables *hoh-hoh-hoh*. Mr. Darwin makes use of this last fact to show that some birds have instrumental means to produce their music. It is not to this point, however, that I wish to call attention, but to the fact of the bird's puffing out the sides of its neck. It is generally supposed that the song of a bird is produced by actions of the lower larynx on air passing up the bronchial tubes onwards and outwards through the main tube, or trachea. The trachea of the Hoopoe is not dilatable, but its œsophagus is ; and the puffing of the neck is caused by the bulging of the œsophagus with swallowed air. There is no connection between the

œsophagus and the trachea, and apparently no organ at the entrance to the former that could modify sound. What action, then, can this swallowed air be made to take in the production of the bird's notes? Pigeons have strikingly large air-crops, which they empty with each *coo*, and refill before they *coo* again. Many birds swell out the throat when calling or singing, and others move it up and down. These actions must also be caused by the swallowed air in the œsophagus, and must modify the sounds in some way, as variously used, adding power and richness in some cases, or giving ventriloquistic effect in others. This question seems never to have been enquired into before, and I throw out the hint in hopes that others may help to elucidate the matter with their investigations."

The length of the Common Hoopoe is about one foot; the upper surface is greyish-brown, the wings and shoulders black barred with white, the rump being pure white; on the head, which is tawny-coloured, is an enormous crest, the feathers of which have a black tip, before which is a narrow white bar; the tail is black, with a white band at about a third of its length from the end; underneath the body is pale cinnamon, white on the abdomen and under tail coverts, the flanks striped with brown. The sexes are alike in colour, excepting that the female is a little paler.

THE WOOD HOOPOES (*Irrisor*).

All the birds belonging to this section of the Hoopoes are remarkable for their very long and strongly graduated tails, for their brilliant metallic plumage, which is always dark, and inclining more or less to black—instead of a sandy colour, as in the true Hoopoes—and most of them for their very curved, scimitar-like bills. They are all natives of Africa, and have a remarkably loud, chattering note; and from its harsh and resounding voice the Red-billed Wood Hoopoe (*I. erythrorhynchus*) is known among the Dutch at the Cape as "Cackala," or the "Chatterer." The late M. Jules Verreaux told the writer that the noise made by these birds is tremendous, and that on one occasion he was attracted by an uproar, which seemed to indicate that something unusual was the matter. On proceeding to the place whence the noise came, he was astonished to find on the low branch of a tree three of these birds, perched one on the back of the other, betokening by their drooping wings and repeated chatterings the utmost consternation and fright. The cause of this was not far to seek, for just below the birds was a cobra, balancing himself in an erect attitude, and perfectly motionless, the only indication of life being the incessant flicking of the animal's tongue. The cacklings of the birds became feebler and feebler, until at last the bottom one fell off the perch and dropped into the extended jaws of the snake, which were ready to receive it; while the other two birds, apparently freed from the spell of the reptile's eye, took to instant flight. Having his gun in his hand, M. Verreaux shot the snake immediately; but on going to rescue the bird, found that the latter was quite dead. Mr. Thomas Ayres, who has studied the species in Natal, says:—"The food of these birds consists almost entirely of a species of cockroach, which they take from the crevices of rough-barked trees, and in search of which they creep about the trunk and branches somewhat similarly to the Woodpeckers. In this manner their tail-feathers frequently become much worn. From four to eight of these birds are generally together, and frequent bushy country. They have a loud chattering note, and are extremely restless in their habits. They have a peculiarly powerful and disagreeable smell." Mr. Andersson's account of the species is as follows:—"It lives in small flocks—probably consisting of entire families—which frequent trees, chiefly of the larger kinds, and examine them most assiduously in search of insects and their larvæ, which they extract from crevices in the wood and from beneath the bark. These birds climb like Woodpeckers; and their long tails come into constant contact with the rough surface of the trees, by which the tail-feathers are much injured. When they have finished their examination of one tree they move to the next convenient one, but not all together, as a short interval generally elapses after the departure of each individual. The moment flight is decided on, they utter harsh discordant cries or chatterings, which are continued until they are all safely lodged in their new quarters. These harsh notes are also heard when they conceive themselves in danger from either man, beast, or bird; and they thus often betray their presence."

The present species measures about seventeen inches, the tail being about ten out of that number, and being thus three inches longer than the body of the bird. The colour is black, glossed with green on the head, back, and under surface, with blue on the throat, purple on the wings and tail,

and having a bronzy gloss on the shoulders. All the tail feathers, except the two centre ones, have a white spot near the tip and across the wings a white bar. The bill and legs are bright coral red.

CHAPTER X.

THE BEE-EATERS—MOTMOTS—ROLLERS—TROGONS—NIGHTJARS, OR GOATSUCKERS—SWIFTS—HUMMING BIRDS.

THE BEE-EATERS—Their Brilliant Plumage—Colonel Irby's Account of the Bird in Spain—Shot for Fashion's sake—THE MOTMOTS—Appearance—Mr. Waterton on the Houtou—Curious Habit of Trimming its Tail—Mr. O. Salvin's Observations on this point—Mr. Bartlett's Evidence—THE ROLLERS—Why so called—Canon Tristram's Account of their Habits—Colour—Other Species—THE TROGONS—Where found—Peculiar Foot—Tender Skin—Inability to Climb—Their Food—THE LONG-TAILED TROGON, OR QUESAL—Mr. Salvin's Account of its Habits—Its Magnificent Colour — How they are Hunted — THE NIGHTJARS, OR GOATSUCKERS — Appearance — Distribution — The Guacharo, or Oil-bird—"Frog-mouths"—Mr. Gould's Account of the Habits of the Tawny-shouldered Podargus—How it Builds its Nest—Mr. Waterton's Vindication of the Goatsucker—What Services the Bird does really render Cattle, Goats, and Sheep—Its Cry—The Common Goatsucker—THE SWIFTS—THE COMMON SWIFT—Migration—Their Home in the Air—Where they Breed—Nest—Tree-Swifts—The Edible-Nest Swiftlets—Mr. E. L. Layard's Visit to the Cave of the Indian Swiftlet—THE HUMMING BIRDS—Number of Species—Distribution—Professor Newton's Description of the Bird—Mr. Wallace on their Habits—Wilson on the North American Species.

THE SIXTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.
THE BEE-EATERS (*Meropidæ*).

THE Bee-eaters are among the most brightly plumaged of the Picarian birds, and are distributed over the whole of Africa, India, the Moluccas, and Australia. One species (*Merops apiaster*) visits Europe in the summer, being, however, nowhere so common as in the countries of the Mediterranean basin, though they occasionally wander to England. Colonel Irby* gives the following account of the Bee-eater in Southern Spain:—"The bird did not appear to me to be quite so common in Morocco at the end of April as on the Spanish side of the Strait, where, during April, May, June, and July, it is one of the most conspicuous birds in the country; at that season, Andalusia without Bee-eaters would be like London without Sparrows. Everywhere they are to be seen; and their single note, *teerp*, heard continually repeated, magnifies their numbers in imagination. Occasionally, they venture into the centre of towns when on passage, hovering round the orange-trees and flowers in some patio or garden. Crossing the Strait for the most part in the early part of the day, flight follows flight for hours in succession. When passing at Gibraltar, they sometimes skim low down to settle for a moment on a bush or a tree, but generally go straight on, often almost out of sight; but their cry always betrays their presence in the air. In some places they nest in large colonies; in others there are, perhaps, only two or three holes. When there are no river-banks or barrancos in which to bore holes, they tunnel down into the ground, where the soil is suitable, in a vertical direction, generally on some slight elevated mound. The shafts to these nests are not usually so long as those in banks of rivers, which sometimes reach to a distance of eight or nine feet in all; the end is enlarged into a round sort of chamber, on the bare soil of which the usual four or five shining white eggs are placed. After a little they become discoloured from the castings of the old birds, the nest being, as it were, lined with the wings and undigested parts of Bees and Wasps. Vast numbers of eggs and young must be annually destroyed by Snakes and Lizards. The latter are often seen sunning themselves at the entrance of a hole among a colony of Bee-eaters; and frequently have I avenged the birds by treating the yellow reptile to a charge of shot. The bills of Bee-eaters, after boring out their habitations, are sometimes worn away to less than half their usual length; but as newly-arrived birds never have these stumpy bills, it is evident that they grow again to their ordinary length. It has often been a source of wonder to me how they have the exertion to make these long tunnels: the amount of exertion must be enormous; but when one considers the holes of the Sand-Martin, it is perhaps not so surprising after all. During my stay at Gibraltar, Bee-eaters decreased very much in the neighbourhood, being continually shot on account of their bright plumage, to put in ladies' hats. Owing to this sad fashion,

* "Ornithology of the Strait of Gibraltar," p. 66.

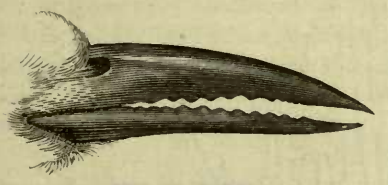
I saw no less than seven hundred skins, all shot at Tangier in the spring of 1874, which were consigned by Olcese to some dealer in London. However, the enormous injury these birds do to the peasants who keep Bees fully merits any amount of punishment, but, at the same time, they destroy quantities of Wasps. After being fired at once or twice, they become very wary and shy at the breeding-places; and the best way to shoot them is to hide near the *colmenares*, or groups of *corchos*, or cork bee-hives, which in Spain are placed in rows, sometimes to the number of seventy or eighty together; and it is no unusual thing to see as many Bee-eaters whirling round and swooping down, even seizing the bees at the very entrance of their hives. The reason of their early departure in August is to be accounted for by the simple fact that bees cease to work when there are no flowers, and by that time all vegetation is scorched up." The Bee-eater suffers probably less from the fashionable rage after its plumes than do some of the bright-coloured birds, as it goes in winter to South Africa, where it rears another brood of young ones.

AUSTRALIAN BEE-EATER.

THE SEVENTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.

THE MOTMOTS (*Momotidæ*).

These birds are peculiar to the New World, being found from Mexico southwards through the whole of Central America and the South American continent. Their general plumage is green, and the majority of the species have a large racket at the end of the centre tail-feathers, formed by the bird itself, as detailed below. Mr. Waterton gives an account of the Motmots in Demerara, and he was the first to point out that the racket in the tail was produced by the bird's own action. He writes:—"The Houtou ranks high in beauty amongst the birds of Demerara. His body is green, with a bluish cast in the wings and tail; his crown, which he erects at pleasure, consists of black in the centre, surrounded with lovely blue of two different shades; he has a triangular black spot, edged with blue, behind the eye, extending to the ear; and on his breast a sable tuft, consisting of nine feathers, edged also with blue. This bird seems to suppose that its beauty can be increased by trimming the tail, which undergoes the same operation as one's hair in a barber's shop, only with this difference, that it uses its own beak, which is serrated, in lieu of a pair of scissors. As soon as his tail is full-grown, he begins about an inch from the extremity of the two longest feathers in it, and cuts away the web on both sides of the shaft, making a gap about an inch long. Both male and female adonise their tails in this manner, which gives them a remarkable appearance amongst all other birds. While we consider the tail of the Houtou blemished and defective, were he to come amongst us, he would probably consider our heads, cropped and bald, in no better light. He who wishes to observe this handsome bird



BILL OF MOTMOT.

in his native haunts must be in the forest at the morning's dawn. The Houtou shuns the society of man; the plantations and cultivated parts are too much disturbed to engage it to settle there. The thick and gloomy forests are the places preferred by the solitary Houtou. In those far-extending wilds, about day-break, you hear him articulate, in a distinct and mournful tone, 'Houtou, houtou.' Move cautiously on to where the sound proceeds from, and you will see him sitting in the underwood, about a couple of yards from the ground, his tail moving up and down every time he articulates 'houtou.' He lives on insects and the berries among the underwood; and very rarely is seen in the lofty trees, except the bastard Siloabali-tree, the fruit of which is grateful to him. He makes no nest, but rears his young in a hole in the sand, generally on the side of a hill."

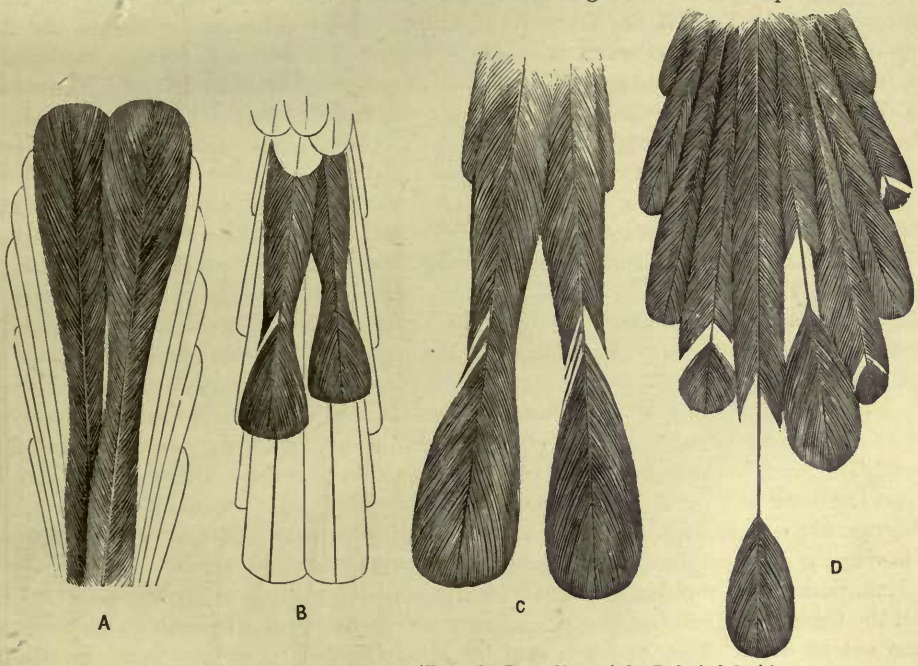
MOTMOT.

In confirmation of Mr. Waterton's remarks, a paper was published by Mr. Osbert Salvin in the "Proceedings of the Zoological Society" for 1873 (p. 429):—"Some years ago (1860) this Society possessed a specimen of *Momotus subrufescens*, which lived in one of the large cages of the parrot-house all by itself. I have a very distinct recollection of the bird; for I used every time I saw it to cheer it up a bit by whistling such of its notes as I had picked up in the forests of America. The bird always seemed to appreciate this attention; for though it never replied, it became at once animated, hopped about the cage, and swung its tail from side to side like the pendulum of a clock. For a long time its tail had perfect spatules; but towards the end of its life I noticed that the median feathers were no longer trimmed with such precision; and on looking at its beak I noticed that from some cause or other it did not *close properly*, but gaped slightly at the tip, and had thus become unfitted for removing the vanes of the feathers. Since the subject has been revived by Dr. Murie, it occurred to me that Mr. Bartlett could hardly have failed to watch this bird during its moults, and whilst the tail-feathers were growing. I accordingly wrote to him, and received the following reply:—

'Dear Sir,—During the several years the Motmot lived here I had many opportunities of watching its habits; and *I have seen the bird in the act of picking off the webs of the central feathers of its tail*, and have taken from the bottom of the cage the fragments of web that fell from the bird's bill. As the bird

lived here for some years, its bill got rather out of order, that is, it did not close properly at the point; and consequently the picking off the web at last was imperfectly performed, and the two sides of the tail-feather presented an unequal and unfinished appearance. I noticed also that the Motmot frequently threw up castings, after the manner of the Kingfishers and other birds that swallow indigestible substances.—Yours faithfully, A. D. Bartlett.'

"The point is further elucidated by the examination of skins in our collection. We have a number of specimens of various species in which the central tail-feathers were growing when the birds were shot. The drawings now exhibited show some of them. Figure A represents the tail of a young *Momotus lessoni* in its first plumage. The central tail-feathers are here untouched; they merely show the reduction in the breadth of the web in the part which is subsequently denuded. Of this more anon. Figure B shows the growing feathers of the tail of a specimen of *Momotus mexicanus;* in this a few vanes have been removed from the left-hand feather. Figure C shows the process of denudation



TAIL-FEATHERS OF MOTMOT. (*From the Proceedings of the Zoological Society.*)

(A) Tail of *M. lessoni*: two Central Rectrices shaded; (B) Tail of *M. mexicanus*: the Central Rectrices, not fully grown, are shaded; (C) Tail of *M. lessoni*, with stems of Central Rectrices partially denuded; (D) Tail of *P. platyrhynchus*, with Central Rectrices not symmetrical.

still further advanced. In all these three birds it will be noticed that the feathers in question have grown symmetrically, both being of nearly equal length. Figure D represents the tail of a *Prionirhynchus platyrhynchus*, where these feathers have not grown symmetrically, but the left-hand one has been developed sooner than the right-hand one. What has happened? The bird expecting to find *two* feathers upon which to operate has commenced to nibble not only the left central rectrix, but also the next rectrix on the right-hand side! But it seems to have not felt very certain about the state of its tail, for it has wandered off to one of the others, and commenced nibbling it also. When, however, the proper right-hand feather appeared, these mistakes have been discovered, and the work recommenced in the usual way. I can interpret in no other way the state in which the feathers on the right-hand side of the tail of this bird appear."

THE EIGHTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.

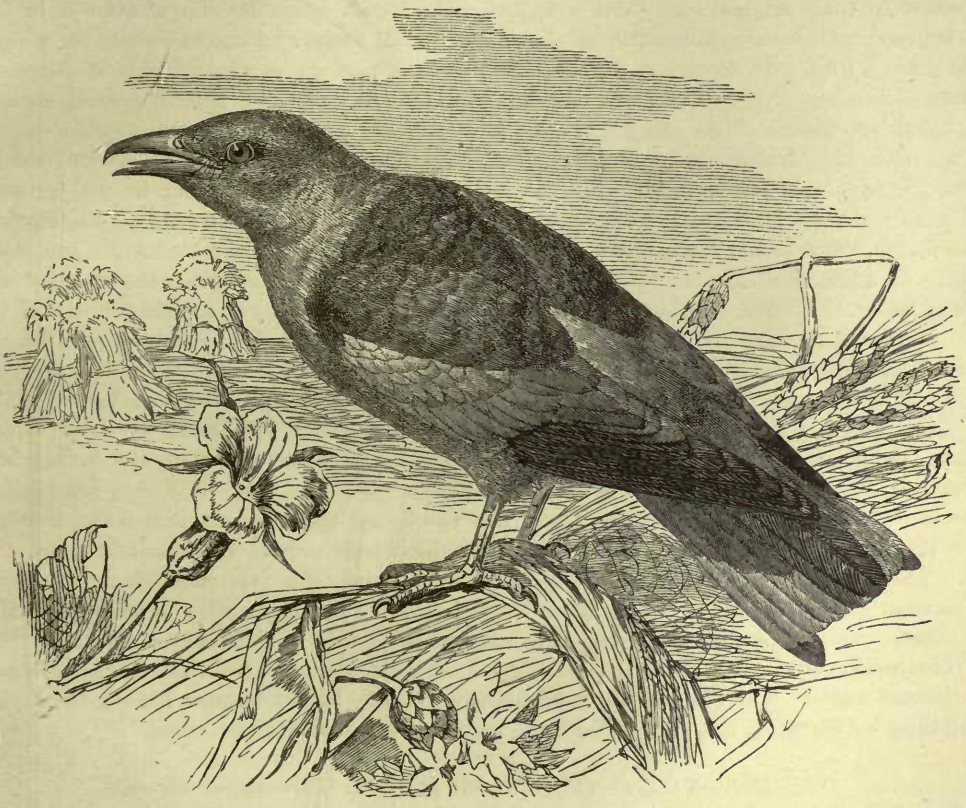
THE ROLLERS (*Coraciadæ*).

These birds constitute a family of birds which are strictly denizens of the Old World, and are remarkable for their bright plumage. The vernacular name of Roller is given to them from their habit of mounting or "rolling" in the air. Canon Tristram, in describing the habits of the European species (*Coracias garrula*) in Palestine, writes as follows:—"On the 12th of April I reached Ain Sultan

(Jericho) alone, and remained there in solitude for several days, during which I had many opportunities of observing the grotesque habits of the Roller. For several successive evenings, great flocks of Rollers mustered shortly before sunset on some *dôm* trees near the fountain, with all the noise but without the decorum of the Rooks. After a volley of discordant screams, from the sound of which it derives its Arabic trivial name of 'Schurkrak,' a few birds would start from their perch, and commence a series of somersaults overhead, somewhat after the fashion of Tumbler Pigeons. In a moment or two they would be followed by the whole flock, and these gambols would be repeated for a dozen times or more. Everywhere it takes its perch on some conspicuous branch or on the top of a rock, where it can see and be seen. The bare tops of the fig-trees, before they put forth their leaves, are, in the cultivated terraces, a particularly favourite resort. In the barren Ghor I have often watched it perched unconcernedly on a knot of gravel or marl in the plain, watching apparently for the emergence of beetles from the sand. Elsewhere I have not seen it settle on the ground. Like Europeans in the East, it can make itself happy without chairs and tables in the desert, but prefers a comfortable easy-chair when it is to be found. Its nest I have seen in ruins, in holes in rocks, in burrows, in steep sand-cliffs, but far more generally in hollow trees. The colony in the Wady Kelt used burrows excavated by themselves; and many a hole did they relinquish, owing to the difficulty of working it. But so cunningly were the nests placed under a crumbling treacherous ledge, overhanging a chasm of perhaps one or two hundred feet, that we were completely foiled in our siege. We obtained a nest of six eggs, quite fresh, in a hollow tree in Bashan, near Gadara, on the 6th of May. It is noticed by Russell among the birds of Aleppo." The colour of the Common Roller is very beautiful, and we can well understand the significance of the Turkish name "Alla Carga," or Beautiful Crow. The back is pale cinnamon-brown; the wing-coverts pale blue, excepting those on the edge of the wing, which are rich ultramarine; the quills brownish-black, deep ultramarine underneath; the secondaries with more blue on the outer web; the forehead white; the crown of the head and back of the neck pale blue; the lower back and rump ultramarine; the upper tail-coverts greenish-blue; the tail blackish-brown, the feathers blue at the base, the two centre feathers dull green; cheeks and throat pale blue, streaked with silvery blue; the under surface of the body pale greenish-blue. The total length is twelve inches. One curious feature about the European bird is that the outer tail-feather tends towards a point at the tip, as if there was an inclination to become elongated; and in Africa there is a species which actually differs from the European Roller only in having the outer tail-feathers elongated to an extent of several inches.

In Madagascar, that wonderful island which produces so many peculiar forms of bird life, there are found the Ground Rollers (*Atelornis*), extraordinary birds which live entirely on the ground, and only come out at dusk. Their flight is said by M. Grandidier to be very weak, so that the birds are never found above the lowest branches. They are rather local in their habitat, but where they do occur seem not to be uncommon. The Cyrombo Roller (*Leptosoma discolor*) is also a native of Madagascar, and has at first sight much the appearance of a Cuckoo, of which family of birds it was for many years considered to be a member. The head is extremely large in this bird, and the region of the nostrils densely plumed; but the latter, instead of being placed near the base of the bill, as in most Rollers, are situated nearly in the middle of the upper mandible. Messrs. Pollen and Van Dam give an interesting account of this bird in their notes on the "Birds of Madagascar":—"The natives of the north-west of Madagascar give this bird the name of Cyrombo. It has the curious habit of hovering in the air, and uttering a very loud note, striking its wings against its body as it calls. This cry, resembling the syllables *tu-hou*, *tu-hou*, *tu-hou*, goes on increasing in force. Nowhere have we found this bird in greater numbers than in the forests in the neighbourhood of the bays of Boény and Jongony, in the south-western portion of the island of Mayotte. The racket that they make during the whole journey is truly wearisome. Although very active as criers, these birds are lazy and stupid. As soon as they are perched on the branch of a tree, they remain, so to speak, immovable, and in perpendicular position, so that it is easy to see them and knock them over. When seen in this position, they look like birds impaled. We suppose that they live in polyandry, because one always sees three times as many males as females; often we have seen three males in company with one single female, and all allowed themselves to be killed one after the other. In fact, when one is killed, the others do not fly away, but content themselves with merely moving from one branch to

another. These birds live principally on Grasshoppers, but they devour also Chameleons and Lizards, which gives to their flesh a disagreeable odour, like that we observe in the Common Cuckoo. In preparing these birds we often found them with a species of large parasite of the family of the Ornithomyiæ, of a dirty green colour. We were never able to study the propagation of this bird; but while in Mayotte we saw an individual make a nest of rushes in the hole of a great 'Badamier' (*Terminalia Catappa*). These birds when they cry puff out the throat, so that this portion of the body has the appearance of a pendent bag. When wounded, they erect the feathers of the forehead and ears as well as those of the throat, all the while distributing well-aimed blows with the beak. The Cyrombo plays a great part in the chants and religious recitations of the Malagasy natives. The



BLUE ROLLER.

French colonists of Mayotte call this bird the 'Parrot.' It is common at Madagascar and Mayotte, and has, according to Mr. Sclater, been found in the island of Anjounan."

THE NINTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.—THE TROGONS (*Trogonidæ*).

These beautiful birds are found both in the Old World and the New, but are inhabitants of the tropical latitudes only. In Africa two species only are known, nor does another species occur until the coast of India is reached, and then in the forests of the peninsula and of the Himalayas there are some beautiful red-breasted representatives of the family, whence throughout the Malayan peninsula and the Sunda Islands some of the handsomest Trogons occur. But it is in America, from Mexico southwards, that the larger number of species is met with, no less than thirty-three out of a total of forty-six Trogons being peculiar to the New World. Their habits vary somewhat, as all the Old World members are insectivorous, while the American species principally feed on fruit, and only devour insects in a secondary manner. The Trogons may be distinguished not only by their broadened bill, but by the foot, where the first and second toes are turned permanently, two in front and two behind. This is a different arrangement to that of the Cuckoos and other

climbing *Picariæ*, where the fourth toe is permanently or temporarily turned backwards as well as the first. The skin of these birds is remarkably thin and tender, so that their preparation is by no means an easy matter, and their appearance is also detracted from by a scantiness of plumage on the nape, where a great want of feathers takes place. Mr. Wallace, writing of the birds of this present family, remarks:—"As an instance how totally unable the Trogons are to use their feet for anything like climbing, we may mention that the Trogons of South America feed principally on fruit, which one would think they would get by climbing or walking after, if they could. But no; they take their station on a bare branch about the middle of the tree, and having fixed their attention on some particularly tempting fruit, they dart at it, seize it dexterously on the wing, and return to their original seat. Often, while waiting under a fruit-tree for Chatterers or Pigeons, have we received the first intimation of the presence of a Trogon by the *whir-r-r* of its wings as it darted after a fruit. It is curious that this habit seems confined to the Trogons of America. In the East I have never yet observed it, and in the numerous specimens I have opened, nothing has been found but insects. The African Trogons also appear to be wholly insectivorous."

Again, in his "Naturalist in Nicaragua" (p. 122) Mr. Belt writes:—"The Trogons are general feeders. I have taken from their crops the remains of fruits, grasshoppers, beetles, termites, and even small crabs and land shells. The largest species, the Massena Trogon (*Trogon massena*), is one foot in length, dark bronze-green above, with the smaller wing-feathers speckled white and black, and the belly of a beautiful carmine. Sometimes it sits on a branch above where the army of ants are foraging below, and when a grasshopper or other large insect flies up and alights on a leaf it darts after it, picks it up, and returns to its perch. I sometimes found them breaking into the nests of the termites with their strong bills, and eating the large soft-bodied workers, and it was from the crop of this species that I took the remains of a small crab and land shell (*Helicina*). They take short, quick, jerking flights, and are often met with along with flocks of other birds—Fly-catchers, Tanagers, Creepers, Woodpeckers, &c., that hunt together, traversing the forests in flocks of hundreds, belonging to more than a score of different species, so that while they are passing over the trees seem alive with them. Mr. Bates has mentioned similar gregarious flocks met with by him in Brazil; and I never went any distance into the woods around St. Domingo without seeing them. The reason of their association together may be partly for protection, as no rapacious bird or mammal could approach the flock without being discovered by one or other of them; but the principal reason appears to be that they play into each other's hands in their search for food. Creepers and Woodpeckers and others drive the insects out of their hiding-places under bark, amongst moss and withered leaves. The Flycatchers sit on branches and fly after the larger insects, the Flycatchers taking them on the wing, the Trogons from the leaves on which they have settled."

THE LONG-TAILED TROGON, OR QUESAL (*Pharomacrus* mocinno*).

This beautiful species is mentioned in Willughby's Ornithology, which was published some two hundred years ago, in which book an appendix is devoted to such birds as the author suspected to be "fabulous;" and the Quetzaltototl of Hernandez was placed in this category, nor was it till the French traveller Delattre visited Guatemala, and published his account of the habits of the bird in 1843, that it was restored to its proper position as one of the most beautiful of the feathered tribe: it is now by no means rare in collections. The best account of the habits of this species—and, indeed, of any Trogon—is that given by Mr. Osbert Salvin, in his paper entitled "Quesal-shooting in Vera Paz,"† in Guatemala. He writes from his diary:—"Off to the mountains at last, with a fine day and a fair prospect of success. The road, after crossing the river, strikes off to the northward—a mountain track winding among the hills. Soon after entering the forest, a river crosses the path—a foaming torrent—a fall into which gives no hope of escape. A felled tree, one of the largest of the forest, forms the bridge, over which, slippery with moss and foam, we have to pass. For ourselves it is nothing; but I must say I tremble for the Indians, each of whom carries his 75lbs. of cargo. In the worst and most slippery part, the foothold is somewhat improved by the tree being notched with a 'machete;' but still it is as dangerous a pass as I ever crossed. After half-an-hour's delay, we reach the other bank. One 'mozo' only turned faint-hearted, and another carried his pack across. From

* φᾶρος, a mantle; μακρός, large. † Ibis, 1861, p. 138.

the river the path becomes very precipitous, and we continue to climb till we reach the foot of a rock, where we find a deserted rancho, and take possession. A fire having been made to heat the pixtones, we dine, and afterwards start for the forest close by to look for Quesals. On entering, the path takes the unpleasant form of a succession of felled trees, which are slippery from recent rains, and render progress slow. My companions are ahead, and I am just balancing myself along the last trunk, when Filipe comes back to say that they have heard a Quesal. Of course, being especially anxious to watch as well as to shoot one of these birds myself, I immediately hurry to the spot. I sit down upon my wide-awake in most approved style close to Cipriano, who is calling the bird, and wait, all eyes and ears, for the result. I have not to wait long. A distant clattering note indicates that the bird is on the wing. He settles—a splendid male—on a bough of a tree, not seventy yards from where we are hidden. Cipriano wants to creep up to within shot, but I keep him back, wishing to risk the chance of losing a specimen rather than miss such an opportunity of seeing the bird in its living state, and of watching its movements. It sits almost motionless on its perch, the body remaining in the same position, the head only moving slowly from side to side. The tail does not hang quite perpendicularly, the angle between the true tail and the vertical being perhaps as much as fifteen or twenty degrees. The tail is occasionally jerked open and closed again, and now and then slightly raised, causing the long tail-coverts to vibrate gracefully. I have not seen all. A ripe fruit catches the Quesal's eye, and he darts from his perch, hovers for a moment, plucks the berry, and returns to his former position. This is done with a degree of elegance that defies description. The remark has often been made by persons looking at stuffed Humming-birds, 'What lovely little things these must look in life, when they are flying about!' But they do not. Place a Humming-bird twenty yards from you, and what do you see of its colours, except in the most favourable position and light? This is not the case with the Quesal. The rich metallic green of the head, back, and tail-coverts reflects its colour in every position, whilst the deep scarlet of the breast and the white of the tail show vividly at a distance, and contrast with the principal colour of the body. The living Quesal strikes the eye by its colour at once. It stands unequalled for splendour among birds of the New World, and is hardly surpassed among those of the Old. Such are my reflections, when a low whistle from Cipriano calls the bird nearer, and a moment afterwards it is in my hand—the first Quesal I have seen and shot.

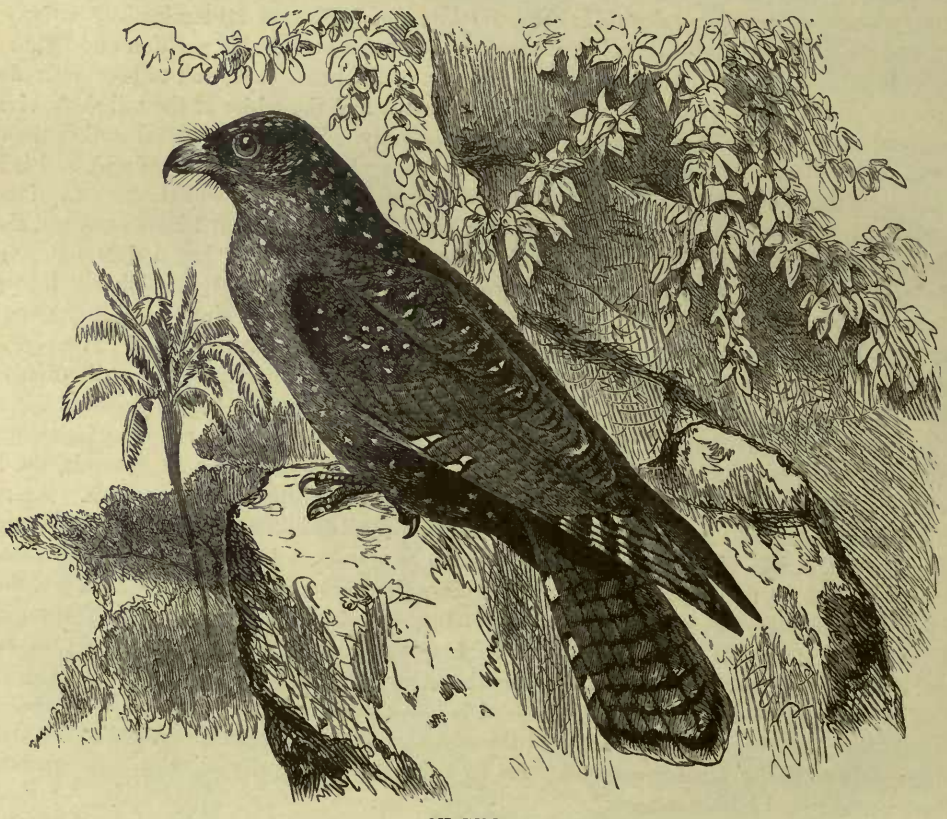
"The cries of the Quesal are various. They consist principally of a low double note, '*whe-oo, whe-oo*,' which the bird repeats, whistling it softly at first, and then gradually swelling it into a loud but not unmelodious cry. This is often succeeded by a long note, which begins low, and after swelling, dies away as it began. Both these notes can be easily imitated by the human voice. The bird's other cries are harsh and discordant. They are best imitated by doubling a pliant leaf over the first fingers, which must be held about two inches apart. The two edges of the leaf being then placed in the mouth, and the breath drawn in, the required sound is produced. Cipriano was an adept at imitating these cries, but I failed in producing them for want of practice. When searching for Quesals, the hunter whistles as he walks along, here and there sitting down and repeating the other notes. As soon as he hears a bird answering at a distance he stops, and imitates the bird's cries until it has approached near enough to enable him either to shoot it from where he stands, or to creep up to within shot. The female generally flies up first, and perches on a tree near the hunter, who takes no notice of her, but continues calling till the male, who usually quickly follows the female, appears. Should the male not show himself, the hunter will sometimes shoot the female. Thus it is that so large a proportion of males are shot. The flight of the Quesal is rapid and straight; the long tail-feathers, which never seem to be in his way, stream after him. The bird is never found except in forests composed of the highest trees, the lower branches of which (*i.e.*, those at about two-thirds of the height of the tree from the ground) seem to be its favourite resort. Its food consists principally of fruit, but occasionally a caterpillar may be found in its stomach."

The distinguishing character of this fine Trogon is the long tail of the male bird, which measures about three feet in length. The colour of the upper parts is golden green, as well as the throat and fore neck; the breast is bright scarlet, and is overshadowed by some beautiful drooping plumes, which spring from the shoulders, and hang gracefully over the wings; the outer tail-feathers are white, with black bases, and the bill is yellow. The female has a black bill, and is much smaller, and she does not possess the long tail and decorative plumes of the male.

THE TENTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.—THE NIGHTJARS, OR GOATSUCKERS (*Caprimulgidæ*).

From the adjoining woodcut it will be seen that a Nightjar is indeed a Fissirostral, or wide-gaping bird, and this large mouth is characteristic of the whole family. Their soft mottled plumage, their large eyes, and their habit of flying by night, have induced many naturalists to place them in close proximity to the Owls, with which family of birds, however, they have nothing further in common. Members of the family of Goatsuckers are distributed nearly all over the world, with the exception of the islands of Oceania, and a great difference is observable in their size and form, and to some extent in their habits. Thus the Guacharo, or Oil-bird (*Steatornis* caripensis*), is met with only in the island of Trinidad, where it is also called *Diablotin*, and where it inhabits the inmost recesses of caverns, either by the sea or inland. The birds spend the entire day in these dark recesses, and come out only at night to procure their food, which consists of the fruits of different palms, the seeds of which are rejected, and form, with the droppings of the birds, a thick flooring of guano in some of the caves. Sometimes the bird forms a huge cradle of this deposit, apparently for the greater security of its young ones; and one of these singular nests, if such they may

MOUTH OF GOATSUCKER.



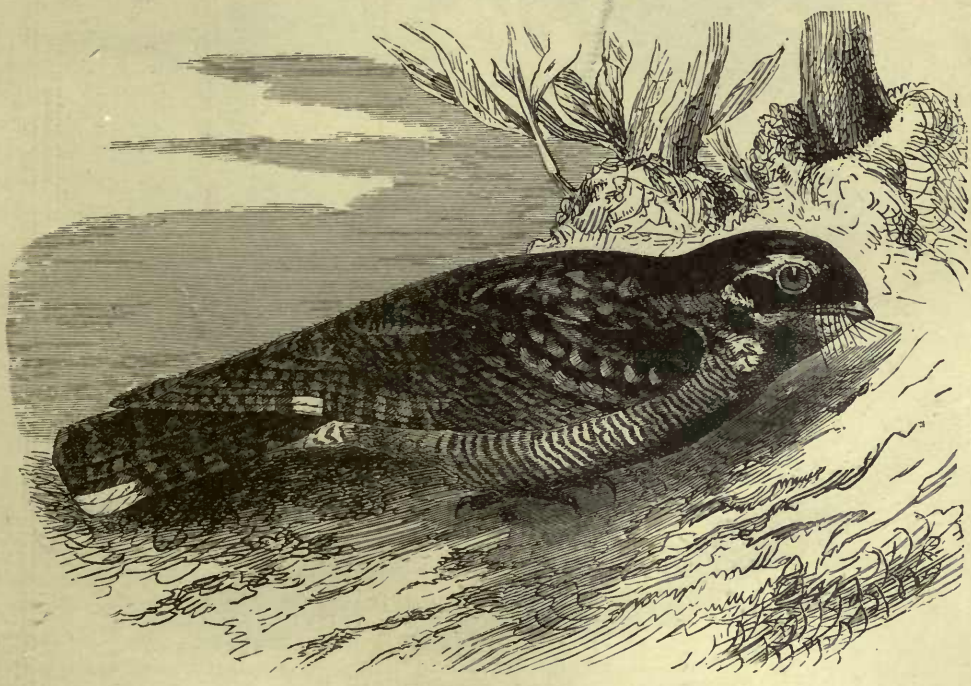
OIL-BIRD.

be called, is exhibited in the British Museum. The nestlings become very fat, and are sometimes eaten, but according to M. Léotand, in his work on the Birds of Trinidad, there is a certain odour about them which makes them unpalatable to the appetite of most people.

In India and in the Malayan Archipelago is found a group of Nightjars belonging to the genus

* στέαρ, στέατος, fat; ὄρνις, a bird.

*Batrachostomus** popularly known as "Frog-mouths;" their place is taken in Australia and New Guinea by the giants of the family—the *Podargi*, examples of which are generally to be seen in the London Zoological Gardens. Of the Tawny-shouldered *Podargus* (*P. strigoides*†) Mr. Gould gives the following account:—"Like the rest of this genus, this species is strictly nocturnal, sleeping throughout the day on the dead branch of a tree, in an upright position across, and never parallel to, the branch, which it so nearly resembles as scarcely to be distinguished from it. I have occasionally seen it beneath the thick foliage of the *Casuarinæ*, and I have been informed that it sometimes shelters itself in the hollow trunks of the *Eucalypti*, but I could never detect one in such a situation; I mostly found them in pairs, perched near each other on the branches of the gums, in situations not at all sheltered from the beams of the midday sun. So lethargic are its slumbers, that it is almost impossible to arouse it, and I have frequently shot one without disturbing its mate, sitting close by; it may also be knocked off with sticks or stones, and sometimes it is even taken with the hand. When aroused, it flies lazily



COMMON GOATSUCKER.

off, with heavy flapping wings, to a neighbouring tree, and again resumes its slumbers until the approach of evening, when it becomes as animated and active as it had been previously dull and stupid. The stomach of one I dissected induced me to believe that it does not usually capture its prey while on the wing, or subsist on nocturnal insects alone, but that it is in the habit of creeping among the branches in search of such as are in a state of repose. The power it possesses of shifting the position of the outer toe backwards, as circumstances may require, is a very singular feature, and may also tend to assist them in their progress among the branches. A bird I shot at Yarrundi, in the middle of the night, had the stomach filled with fresh-captured Mantis and Locusts (*Phasmidæ* and *Cicadæ*), which seldom move at night, and the latter of which are generally resting against the upright boles of the trees. In other specimens I found the remains of small Coleoptera, intermingled with the fibres of the roots of what appeared to be a parasitic plant, such as would be found in decayed and hollow trees. The whole contour of the bird shows that it is not formed for extensive flight or for performing those rapid evolutions that are necessary for the capture of its prey in the air: the wing being short and concave in comparison with those of the true aërial Nightjars, and particularly with the Australian form, to which I have given the name of *Eurostopodus*.

* βάτραχος, a frog; στόμα, a mouth. † Owl-like.

"Of its mode of nidification I can speak with confidence, having seen many pairs breeding during my rambles in the woods. It makes a slightly-constructed flat nest of sticks, carelessly interwoven together, and placed at the fork of a horizontal branch of sufficient size to ensure its safety; the trees most frequently chosen are the *Eucalypti*, but I have occasionally seen the nest on an apple-tree (*Angophora*) or a swamp-oak (*Casuarina*). In every instance one of the birds was sitting on the eggs, and the other perched on a neighbouring bough, both invariably asleep. That the male participates in the duty of incubation I ascertained by having shot a bird on the nest, which, on dissection, proved to be a male. The eggs are generally two in number, of a beautiful immaculate

WHIP-POOR-WILL.

white, and of a long oval form, one inch and ten lines in length by one inch and three lines in diameter.

"Like the other species of the genus, it is subject to considerable variation in its colouring, the young, which assume the adult livery at an early age, being somewhat darker in all their markings. In some a rich tawny colour predominates, while others are more grey. The night call of this species is a hoarse noise, consisting of two distinct sounds, which cannot correctly be described. The stomach is thick and muscular, and is lined with a hair-like substance, like that of the common Cuckoo."

Mr. Waterton gives the following notes on Goatsuckers in his "Wanderings" (p. 139):—"When the sun has sunk in the western woods, no longer agitated by the breeze, when you can only see a straggler or two of the feathered tribe hastening to join its mate, already at its roosting-place, then it is that the Goatsucker comes out of the forest, where it has sat all day long in slumbering ease, unmindful of the gay and busy scenes around it. Its eyes are too delicately formed to bear the light, and thus it is forced to shun the flaming face of day, and wait in patience till night invites him to partake of the pleasures her dusky presence brings. The harmless, unoffending Goatsucker, from the time of Aristotle down to the present day, has been in disgrace with man. Father has handed it down to son, and author to author, that this nocturnal thief subsists by

milking the flocks. Poor injured little bird of night, how sadly hast thou suffered, and how foul a stain has inattention to facts put upon thy character! Thou hast never robbed man of any part of his property, nor deprived the kid of a drop of milk.

"When the moon shines bright you may have a fair opportunity of examining the Goatsucker. You will see it close by the Cows, Goats, and Sheep, jumping up every now and then under their bellies. Approach a little nearer—he is not shy: 'he fears no danger, for he knows no sin.' See how the nocturnal flies are tormenting the herd, and with what dexterity he springs up and catches them as fast as they alight on the bellies, legs, and udders of the animals. Observe how quiet they stand, and how sensible they seem of his good offices, for they neither strike at him nor hit him with their tails, nor tread on him, nor try to drive him away as an uncivil intruder. Were you to dissect him and inspect his stomach, you would find no milk there. It is full of the flies which have been annoying the herd.

"The pretty mottled plumage of the Goatsucker, like that of the Owl, wants the lustre which is observed in the feathers of the birds of day. This at once marks him as a lover of the pale moon's nightly beams. There are nine species here (Demerara); the largest appears nearly the size of the English Wood Owl. Its cry is so remarkable that, having once heard it, you will never forget it. When night reigns over these immeasurable wilds, whilst lying in your hammock, you will hear this Goatsucker lamenting like one in deep distress. A stranger would never conceive it to be the cry of a bird; he would say it was the departing voice of a midnight murdered victim, or the last wailing of Niobe for her poor children before she was turned into stone. Suppose yourself in hopeless sorrow, begin with a high loud note, and pronounce 'Ha, ha, ha, ha, ha, ha, ha!' each note lower and lower, till the last is scarcely heard, pausing a moment or two betwixt every note,

LYRE-TAILED NIGHTJAR.

and you will have some idea of the moaning of the largest Goatsucker in Demerara. Four other species of the Goatsucker articulate some words so distinctly that they have received their names from the sentences they utter, and absolutely bewilder the stranger on his arrival in these parts. The most common one sits down close by your door, and flies, and alights three or four yards before you as you walk along the road, crying 'Who are you, who-who-who-are-you.' Another bids you 'Work away, work-work-work-away.' A third cries mournfully, 'Willy-come-go, willy-willy-willy-come-go.' And high up in the country a fourth tells you to 'Whip-poor-will, whip-whip-whip-poor-will.' You will never persuade the negro to destroy these birds, or get the Indian to let fly his arrows at them. They are birds of omen and reverential dread. Jumbo, the demon of Africa, has them under his command, and they equally obey the Yabahou, or Demeraran Indian Devil. They are receptacles for departed souls who come back again to earth, unable to rest for crimes done in their days of nature; or they are expressly sent by Jumbo or Yabahou to haunt cruel or hard-hearted monsters, and retaliate injuries received from them. If the largest Goatsucker chance to cry near the white man's door, sorrow and grief will soon be inside; and they expect to see the master waste away with a slow consuming sickness. If it be heard close to the negro's or Indian's hut, from that night misfortune sits brooding over it, and they await the event in terrible suspense."

The common Goatsucker, which is also popularly known as the "Fern Owl," or "Nightjar," visits England only in the spring, when it arrives from Southern Africa, and distributes itself over the country. It is by no means an uncommon bird, but is rarely seen, owing to its habit of coming out only at night, or at least in the twilight. They may then often be disturbed from the ground in a country road, when they take to flight in a heavy manner, often making a flapping noise, which appears to be caused by bringing the wings sharply together above the body of the bird. The call-note may be described as "churring," and is disagreeable in sound; it is generally uttered by the Goatsucker when sitting on a low branch of a tree or on a railing. It should be mentioned that the Caprimulgidæ do not, as a rule, sit crosswise on a branch, but always along the latter; their favourite haunt, however, is generally the ground, and it is supposed by some naturalists that the curious pectinated claw is used by the Goatsucker for scratching the ground. Dr. Günther, F.R.S., who kept one of these birds alive, says that it frequently used its comb-like claw for this purpose. Other people have thought that its claw was intended for clearing away the *débris* of moths and other insects, which would clog the bristles on the bill. The true use of this comb-like appendage on the foot has not yet, however, been thoroughly determined.

FOOT OF THE COMMON GOATSUCKER.

THE ELEVENTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.

THE SWIFTS (*Cypselidæ*).

These birds, with the Humming-birds, are separated from the other Fissirostral *Picariæ* by many anatomical characters, the chief being the arrangement of the feather-tracts on the body, which are quite peculiar; the muscles are also unlike those of the other families, and hence these two groups are often divided off by modern naturalists under the name of *Macrochires.**

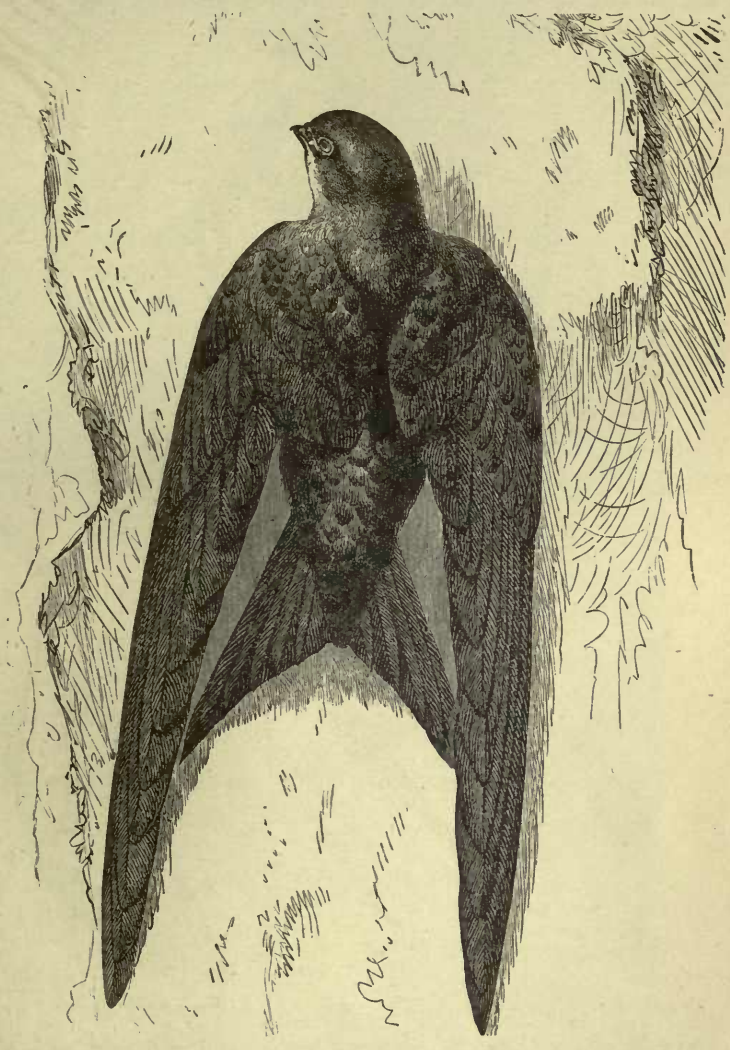
THE COMMON SWIFT (*Cypselus apus*).†

In the beginning of May the Common Swift comes to Great Britain and the rest of Europe, after passing his winter sojourn in South Africa. He is one of the latest arrivals, as he comes only when summer has fairly begun and fine weather is pretty well assured; again, in autumn, he is almost the first of the summer migrants to take his departure, and the absence of the Swifts from their accustomed haunts is a sure sign of the approach of the fall of the year. So incumbent does this early migration seem to be upon the species, that the Swifts have been known to leave their young to perish of starvation rather than delay their departure if cold weather suddenly

* μακρός, long; χείρ, a hand, in the sense of a wing of a bird.

† Cypselus, a swift; α, not; πούς, a foot.

approaches. All birds appear to have at times a failure of instinct, and the Swift is no exception to the rule, for sometimes they are caught in some cold weather on their arrival, and it is not uncommon to find them benumbed with cold, and fluttering helplessly or even lying dead on the ground. In this latter position they are peculiarly helpless, their little legs being unable to raise them so as to give them the proper momentum to rise into the air again, while their long wings are much in the way, and only assist in their entire discomfiture. The home of the Swift, then, is in the air, and here his evolutions are most rapid, and performed with extreme quickness and yet with consummate ease. For his breeding home he often selects water-spouts on lofty buildings, such as the English cathedrals, or else places his nest under the roofs of houses, to the edge of which he is able to shuffle, and then to launch himself suddenly down, after which his course is easy. In the evening there is generally a little gathering of Swifts together, when they fly screaming round and round the buildings in which their nests have been placed, separating again for a few moments to rejoin in an excited flock, which passes with incredible swiftness and much noise round the edges of the towers or homesteads. When about to migrate, however, they are silent, and the flocks which may be seen coursing along the sides of the downs in the southern counties of England in August utter no sound, as if impressed with the gravity of the long journey they are about to undertake.



COMMON SWIFT.

Macgillivray describes the nest of the Common Swift as follows:—"It is very rudely constructed, flattened, about six inches in diameter and half an inch thick; composed of particles of Aira cæspitosa, straws of oats, wheat, and grasses, intermixed with fibrous roots, moss, wool, cotton, hair, and feathers of the domestic fowl, partridge, and rook. These materials are confusedly felted and agglutinated, the glueing matter being of a gelatinous, not of a resinous, nature, and in extremely thin shreds, which crackle, but do not readily burn, when flame is applied to them. There is, however, a small quantity of the membranous scales of the Scotch fir, together with some resinous matter, in one of these nests." The eggs are generally two in number, of a long oval shape, and entirely white.

Swifts appear to be found all over the world, the most graceful being perhaps the Tree Swifts (*Dendrochelidon*), which inhabit India and the Malayan region. In this same part of the world are also found the Edible-nest Swiftlets (*Collocalia*), which breed in caves, their nests being eaten by the

Chinese and other Asiatic people. Dr. Jerdon says:—"The nest, when pure and of the first make, is composed entirely of inspissated mucus from the large salivary glands of the bird. It is very small, bluntly triangular in form, and slightly concave within; of a semi-transparent, fibrous sort of texture, bluish-white in colour, and with the fibres, as it were, crossed and interlaced. When the nests of the first make are taken away, the second nests are mixed with feathers, and occasionally other foreign substances. The eggs are two in number, and pure white." Mr. E. L. Layard gives the following account of a visit to a cave inhabited by the Indian Swiftlet in Ceylon:—"I have at last visited the

TREE SWIFT.

cave in which *Collocalia nidifica** builds, and will now, with the aid of my journal, give all the information I can, sending you birds skinned and in spirit, and a young nestling taken from the nest with my own hand. The cave is situated at a place called Havissay, about thirty-five miles from the sea and twenty from the river, and about 500 feet up a fine wood-clad hill, called Diagallagoolawa, or Hoonoomooloocota. Its dimensions are as follows:—Length between fifty and sixty feet, about twenty-six broad, and twenty high. It is a mass of limestone rock, which has cracked off the hill-side, and slipped down on to some boulders below its original position, forming a hollow triangle. There are three entrances to the cave; one at each end, and one very small one in the centre. The floor consists of large boulders, covered to the depth of two or three inches with the droppings of the birds, old and young, and the bits of grass they bring in to fabricate their nests. The only light which penetrates the cavern from the entrances above mentioned is very dim. When my eyes, however, got accustomed

* Nest-building.

EDIBLE-NEST SWIFTLETS.

to the light, I could see many hundreds of nests glued to the side of the fallen rock, but none to the other side, or hill itself. This I attribute to the fact of the face of the main rock being evidently subject to the influence of the weather, and perhaps to the heavy dews off the trees; but for this, the side in question would have been far more convenient for the birds to have built on, as it sloped gently outward, whereas the other was much overhung, and caused the birds to build their nests of an awkward shape, besides taking up more substance. I was at the spot a few days before Christmas, and fancy that must be about the time to see the nests in perfection. This is corroborated by the fact of my finding young birds in all the nests taken by me, and by what the old Chinaman said, that the 'take' came on in October. I find that they have three different qualities of nests, and send two for your inspection. The best is very clean, white as snow, and thin, and is also very expensive. The most inferior are composed of dry grasses, hair, &c., but I could not detect anything like the bloody secretion, as described ('though only under peculiar circumstances of exhaustion') by Mr. Barbe, even in a fresh nest. I was in the cave late (after 5 P.M.) in the evening of a day which threatened rain, but the old birds were still flying round the summit of the mountain at a vast altitude, occasionally dashing down into the cave with food for their nestlings. By daylight next morning I was on foot, but the birds were before me, hawking on the plain below and all about the hills. I have found the birds here, in Colombo, in Kandy, and all along the road we went. I could learn nothing of the number of eggs laid, nor of their colour. I found one bird in each nest. The Chinese who live on the spot pretend not to understand anything asked them, and the apathetic Cingalese have never taken the trouble to see for themselves, so they could give me no information. The aspect of the country, broken and rugged, coupled with the numerous flocks of birds I saw flying round the various hills, leads me to think there must be many breeding-places yet undiscovered. One, however, was pointed out, but we had not time to visit it. I could not hear of any other kind of *Swift* breeding there, but have just received such information as leads me to suppose that *C. fuciphaga* builds near Jaffna on some rocks overhanging the sea. I may further add that there were no Bats in the cave with *C. nidifica*, nor did I see any bird of prey, save a fine *Hæmatornis*, which I shot. The Cingalese name for *C. nidifica* is *Wahlæna*."

WHITE-THROATED SPINE-TAILED SWIFT.

THE TWELFTH FAMILY OF THE FISSIROSTRAL PICARIAN BIRDS.—THE HUMMING BIRDS (*Trochilidæ*).

These exquisite little creatures are perhaps the largest family of birds known, numbering, at the present day, nearly five hundred species. It is simply impossible in a work like the present to do

more than allude to a family, the full description of which by Mr. Gould has occupied five large folio volumes. An immense variety of form and colour is presented to us. All the birds are of small size, some of them being no larger than Hawk-moths, to which in their manner of flight they bear considerable resemblance.

In some countries Humming-birds are tolerably common, but some species are of extreme rarity, such, for instance, as the *Loddigesia mirabilis*, which was discovered forty years ago, and still remains

SWORD-BILL HUMMING BIRD.

represented by a single specimen in the collection of the late Mr. George Loddiges, and of which a reward of fifty pounds, offered by Mr. Gould, has not succeeded in obtaining a second example. As a rule, Humming-birds are a Neotropical family, that is to say, the vast majority of the species occur in South America, and do not wander above the line of Northern Mexico; but a few species are found in the Southern United States, while one occurs in summer even in North America, ranging as far as, and even breeding in, Canada. Professor Newton writes:—"Wilson, Audubon, Mr. Gosse, and several others gifted with 'the pen of a ready writer,' have so fully described, as far as words will admit, the habits of different members of the family *Trochilidæ*, that it is unnecessary to say much on this score. Their appearance is so entirely unlike that of any other birds that it is hopeless to attempt

in any way to bring a just conception of it to the ideas of those who have not crossed the Atlantic; and even the comparison so often made between them and the *Sphingidæ*, though doubtless in the main true, is much to the advantage of the latter. One is admiring the clustering stars of a scarlet *Cordia*, the snowy cornucopias of a *Portlandia*, or some other brilliant and beautiful flower, when between the blossoms and one's eye suddenly appears a small dark object, suspended as it were between four short black threads meeting each other in a cross. For an instant it shows in front of the flower; an instant more it steadies itself, and one perceives the space between each pair of threads occupied by a grey film; again another instant, and, emitting a momentary flash of emerald and sapphire light, it is vanishing, lessening in the distance as it shoots away, to a speck that the eye cannot take note of—and all this so rapidly that the word on one's lips is still unspoken, scarcely the thought in one's mind changed. It was a bold man or an ignorant one who first ventured to depict Humming birds flying; but it cannot be denied that representations of them are often of special use to the ornithologist. The peculiar action of one, and probably of many or all other species of the family, is such, that at times in flying it makes the wings almost meet, both in front and behind, at each vibration. Thus, when a bird chances to enter a room it will generally go buzzing along the cornice. Standing beneath where it is, one will find that the axis of the body is vertical, and each wing is describing a nearly perfect semicircle. As might be expected, the pectoral muscles are very large; indeed, the sternum of this bird is a good deal bigger than that of the common Chimney Swallow (*Hirundo rustica*). But the extraordinary rapidity with which the vibrations are effected seems to be chiefly caused by these powerful muscles acting on the very short wing-bones, which are not half the length of the same parts in the Swallow; and accordingly, great as this alar action is, and in spite of the contrary opinion entertained by Mr. Gosse, it is yet sometimes wanting in power, owing, doubtless, to the disadvantageous leverage thus obtained; and the old authors must be credited who speak of cobwebs catching Humming birds. On the 3rd of May, 1857, a bird of this species flew into the room where I was sitting, and after fluttering for some minutes against the ceiling, came in contact with a deserted spider's web, in which it got entangled, and remained suspended and perfectly helpless for more than a minute, when by a violent effort it freed itself. I soon after caught it, still having fragments of the web on its head, neck, and wings; and I feel pretty sure, that had this web been inhabited and in good repair, instead of being deserted and dilapidated, the bird would never have escaped."

WHITE-BOOTED RACKET TAIL.

Mr. A. R. Wallace has written the following account of the habits of Humming birds on the River Amazon:—"The greater number of species that frequent flowers do so, I am convinced, for

the small insects found there, and not for the nectar. In dozens, and perhaps hundreds, of common flower-frequenting species which I have examined, the crop, stomach, and intestines have been filled with minute beetles, ants, and spiders, which abound in most flowers in South America. Very rarely indeed have I found a trace of honey or of any liquid in the crop or stomach. The flowers they most frequent are the various species of *Inga* and the papilionaceous flowers of many large forest trees. I have never seen them at the bignonias, or any flowers but those which grow in large masses, covering a whole tree or shrub, as they visit perhaps a hundred flowers in a minute and never stop at a single one. The little Emerald Hummer I have seen in gardens and at the common orange (*Asclepias*), which often covers large spaces of waste ground in the tropics. But there are many, such as *Phaëthornis eremita* and some larger allied species, which I

COMMON TOPAZ HUMMING BIRD.

have never seen at flowers. These inhabit the gloomy forest-shades, where they dart about among the foliage; and I have distinctly observed them visit in rapid succession every leaf on a branch, balancing themselves vertically in the air, passing their beak closely over the under surface of each leaf, and thus capturing, no doubt, any small insects that may be upon them. While doing this, the two long feathers of the tail have a vibrating motion, apparently serving as a rudder to assist them in performing the delicate operation. I have seen others searching up and down stems and dead sticks in the same manner, every now and then picking off something, exactly as a Bush Shrike or Tree Creeper does, with this exception, that the Humming-bird is continually on the wing. They also capture insects in the true Fissirostral fashion. How often may they be seen perched on the dead twig of a lofty tree—the station that is chosen by the tyrant Flycatchers and the Jacamars—from which, like those birds, they dart off a short distance, and after a few whirls and balancings return to the identical twig they had left. In the evening, too, just after sunset, when the Goatsuckers are beginning their search after insects over the

rivers. I have seen Humming birds come out of the forest and remain a long time on the wing—now stationary, now darting about with the greatest rapidity, imitating in a limited space the evolutions of their companions the Goatsuckers, and evidently for the same end and purpose."

Wilson, the poet-naturalist, observes of the North American species as follows:—"Nature in every department of her works seems to delight in variety, and the present subject is almost as singular for its minuteness, beauty, want of song, and manner of feeding, as the Mocking Bird is for unrivalled excellence of note and plainness of plumage. This is one of the few birds that are universally beloved, and amidst the sweet dewy serenity of a summer's morning his appearance amongst the arbours of honeysuckles and beds of flowers is truly interesting.

"'When morning dawns, and the blest sun again
Lifts his red glories from the Eastern main,
Then through our woodbines, wet with glittering dews,
The flower-fed Humming bird his round pursues;
Sips with inserted tube the honied blooms,
And chirps his gratitude as round he roams;
While richest roses, though in crimson drest,
Shrink from the splendour of his gorgeous breast,
What heavenly tints in mingling radiance fly!
Each rapid movement gives a different dye:
Like scales of burnished gold they dazzling show,
Now sink to shade, now to a furnace glow.'"

CRESTED HUMMING BIRD.

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